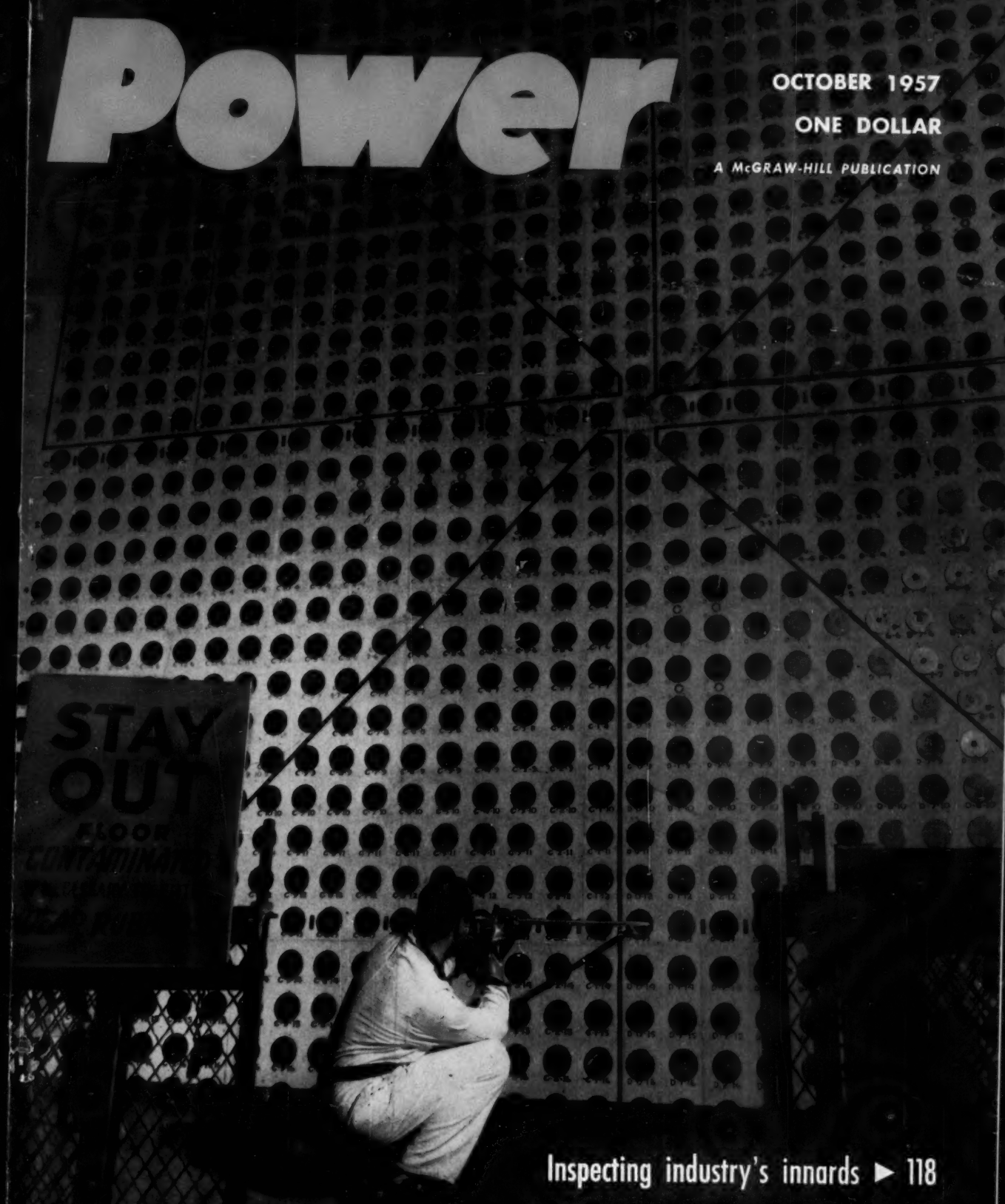
75th Year of editorial service to power progress

Power

OCTOBER 1957
ONE DOLLAR
A McGRAW-HILL PUBLICATION



Inspecting industry's innards ► 118

CONSOLIDATED "ELECTROMATIC" RELIEF VALVE

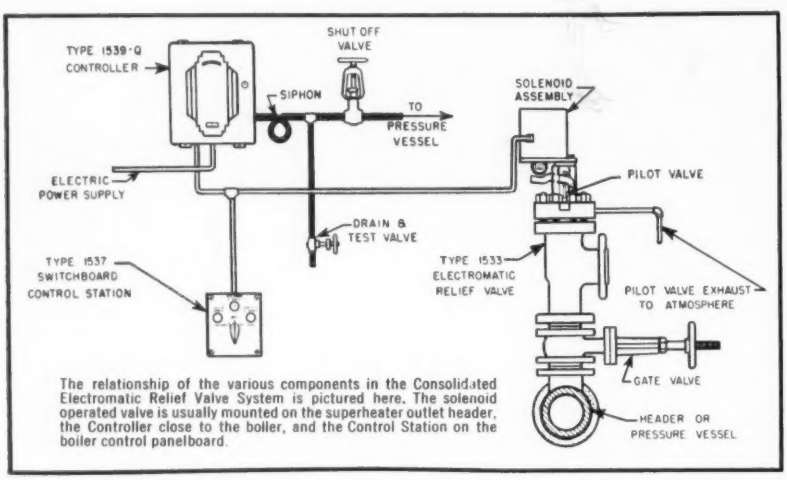
REDUCES POSSIBILITY OF SUPERHEATER DAMAGE

IN H-P, H-T BOILER START-UPS

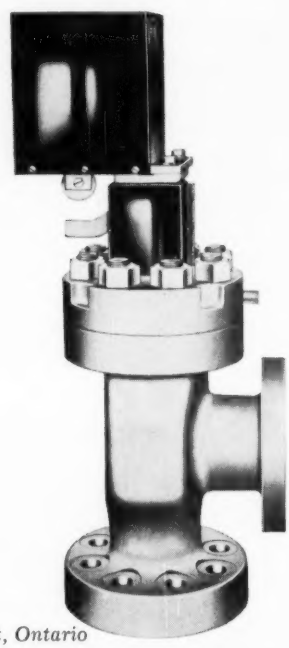
The Electromatic is an automatic relief valve widely used to purge superheaters to obtain faster start-ups or to serve as a superheater surge vent valve. It greatly minimizes the possibility of burning out the superheater elements when firing up a cold steam generator or a banked boiler – saves both fuel and pure water.

The valve is operated by a solenoid actuated by a control station on the panelboard. Merely setting the switch provides automatic or manual service or cuts the valve out of operation. Pressures are relieved precisely within close limits with "quick as a wink" cyclic action. The valve can be set for a differential as low as 1% between opening and closing pressures. High superheat temperatures or other variables do not affect valve operation. A constant maximum pressure output is maintained on the superheaters.

The Electromatic is the ideal auxiliary valve for steam generating plants with pressures to 3000 psi and temperatures to 1120° F. As an auxiliary, it becomes the "working" valve, saving "wear and tear" on the spring-loaded safety valves and reducing substantially the chances of damage to other costly equipment. At the same time power is conserved, plant efficiency is increased and less maintenance is required. The Consolidated Electromatic Relief Valve is available in 2½", 4", 10" and 14" sizes. Get complete specifications and operational details. Send for Bulletin 720.



The relationship of the various components in the Consolidated Electromatic Relief Valve System is pictured here. The solenoid operated valve is usually mounted on the superheater outlet header, the Controller close to the boiler, and the Control Station on the boiler control panelboard.

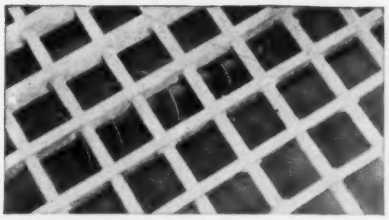


In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

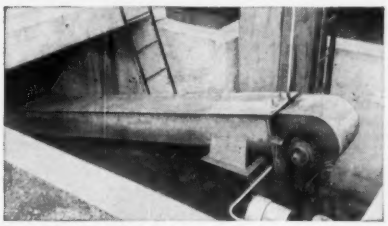
CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

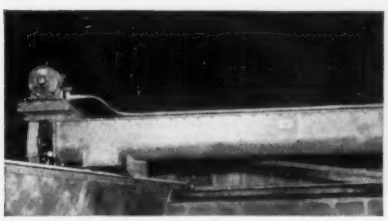


TRUCK HOPPER at foot of bucket elevator receives coal direct from trucks.

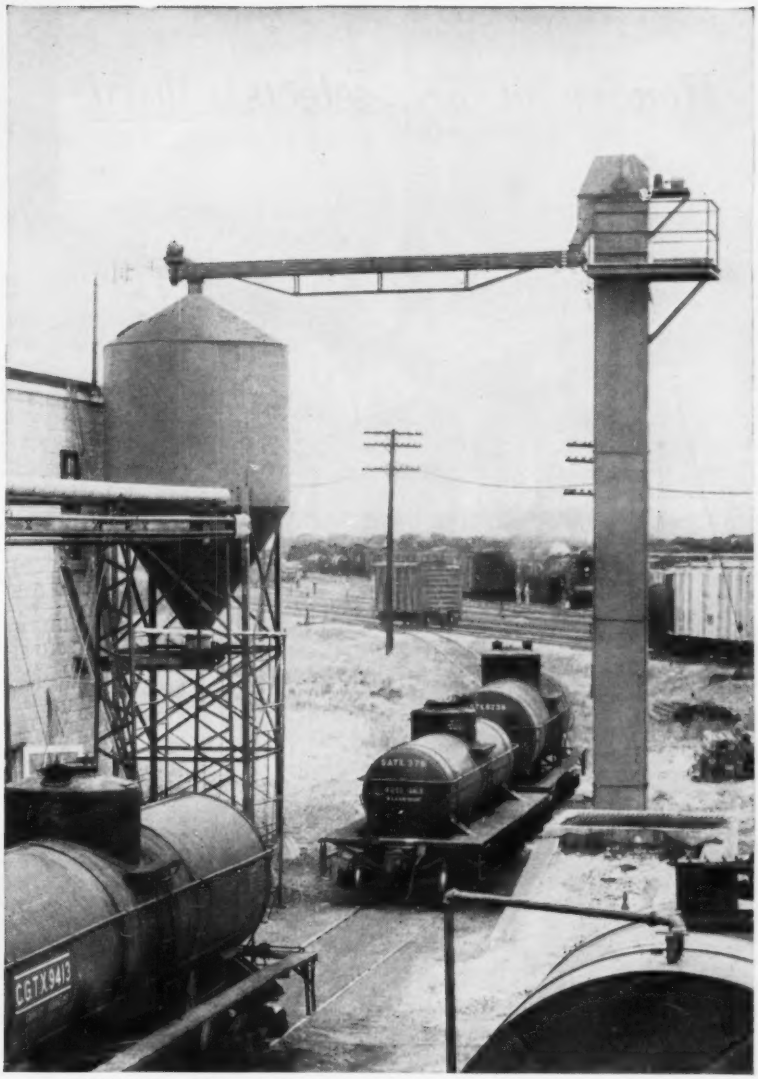


SCREW FEEDER conveys coal from hopper to bucket elevator.

ENCLOSED SCREW CONVEYOR moves coal from elevator to 40-ton storage bin.



STOKER HOPPER (indoors) is filled by screw conveyor from outside storage bin.



MECHANIZED COAL HANDLING SYSTEM at this plant is designed and equipped by Link-Belt to handle 13 tph of minus 1½-in. stoker coal which is delivered by truck.

Why process plants like this...needing uninterrupted steam supply...

come to LINK-BELT for coal handling

Reliable system answers demands of continuous processing

MAINTAINING round-the-clock steam output, this coal handling system shows how Link-Belt duplicates big power plant dependability for small boiler houses. Whether you handle one ton or 2,000 tons of coal per hour, you can rely on this single source for all your coal handling needs—a complete system or an individual component.

In addition, Link-Belt offers you vast experience in plant design. We will work with you and your engineers from planning through erection to bring you lowest per-ton handling costs. For complete information, call your nearby Link-Belt office. Or write for Book 2410.

14,012

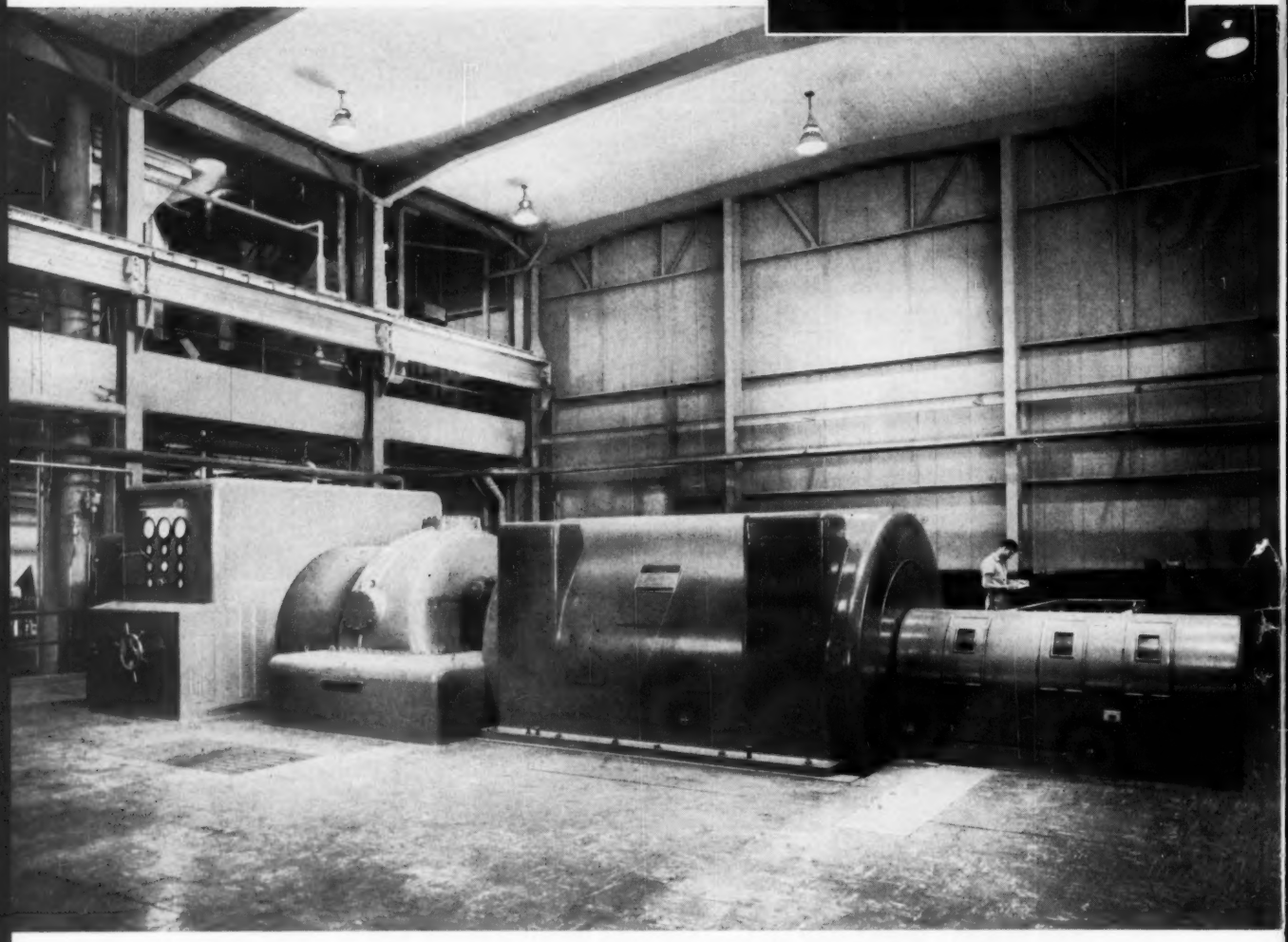
LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

Henderson, Ky., selects a third

DE LAVAL
TURBINE
GENERATOR



In 1950,...
two De Laval 5,000 kw multi-stage turbine generators were installed in the central station of Henderson, Kentucky. These units operated so dependably that the City of Henderson ordered a new, larger De Laval turbine generator to meet their increased power requirements.

Put on the line in 1956,...
this 12,650 kw De Laval machine is an AIEE-ASME Preferred Standard Unit. It operates at 600 psig and 825F; the turbine speed is 3,600 rpm.

De Laval multi-stage turbines are rugged in construction, economical to run. Transmission of power may be either direct or through speed reducing gears. De Laval multi-stage steam turbines are available for all services, including operation at the high pressures, high temperatures employed in steam plants of the latest design. Units are built in sizes up to 25,000 hp.

DE LAVAL *Turbine Generators*

DE LAVAL STEAM TURBINE COMPANY
815 Nottingham Way, Trenton 2, New Jersey

DL-380

Power

OCTOBER 1957 • VOLUME 101 NUMBER 10

ENGINEERING AND MANAGEMENT

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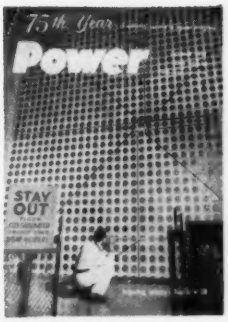

ATOMIC APPLICATION of new borescope is highlighted on this month's cover. Here, a technician uses instrument to inspect inner part of a reactor. Borescope works like a periscope with built-in flashlight to illuminate area under inspection. It gets to the heart of enclosed areas in boilers, engines, reactors, etc without dismantling equipment. Story on page 118.

Next month...

Waste treatment becomes more important as state and federal regulations are enacted to prevent stream pollution. And it often makes possible recovery of usable water. Upcoming article, first in a series, surveys the problem of industrial wastes, outlines treatment methods in use today.

Electric power needs doubled when McGraw-Hill turned on its new air-conditioning system this summer. These huge new power demands were supplied by a bus-duct distribution system believed to be largest ever installed in an existing building. Upcoming 3-pager tells how it was done.

Soot blowers get the full editorial treatment in a 2-part series starting in November. Part I deals with boiler design, trends in fuels and steam pressure-temperature conditions.

. . . and a future month

Field testing of centrifugal pumps is proving to be a useful maintenance tool. December 8-pager wraps up latest thinking on this important subject.

October 1957 **POWER** **Vol 101—No. 10**

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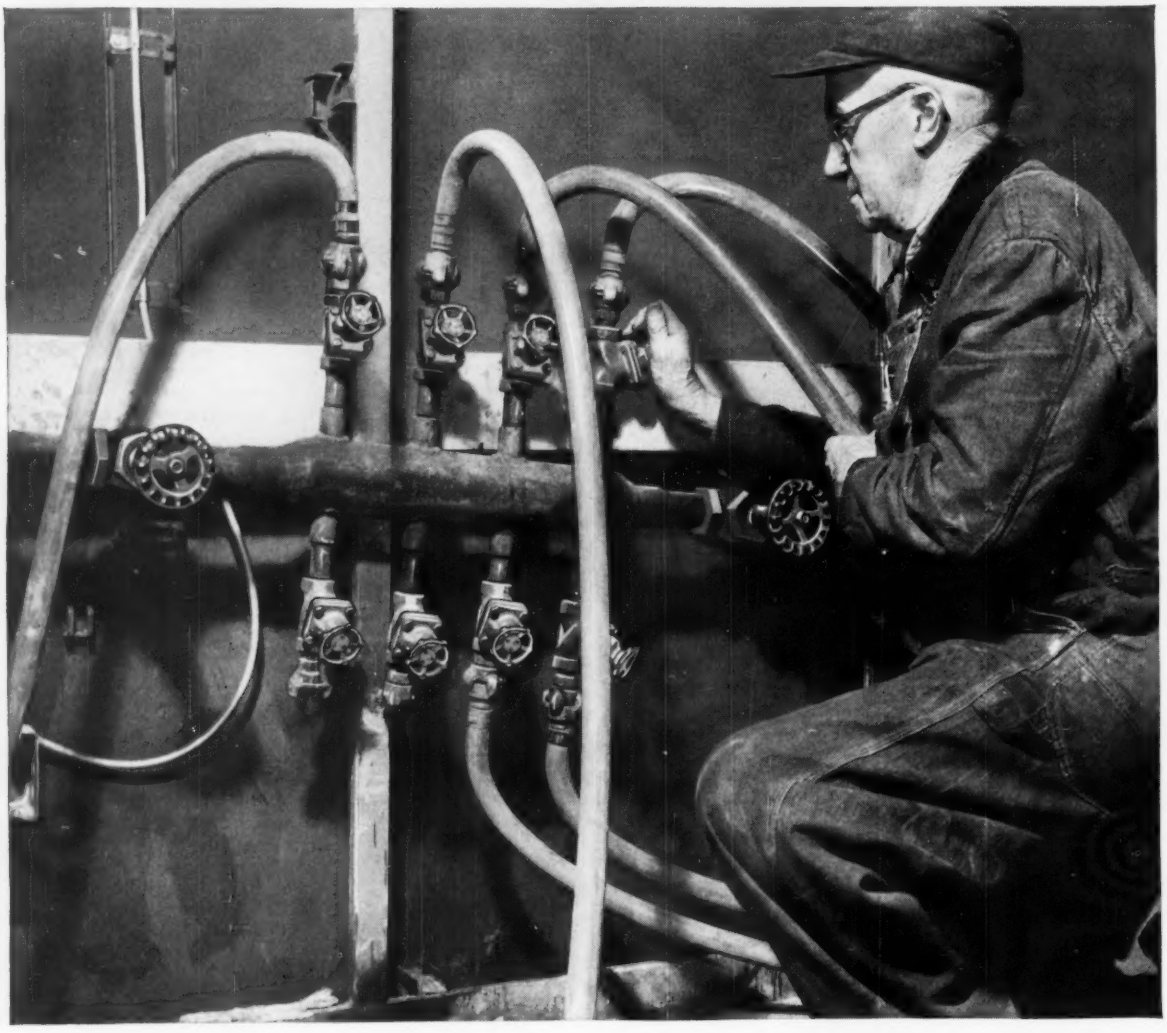
Crane helps another valve user stop high replacement costs

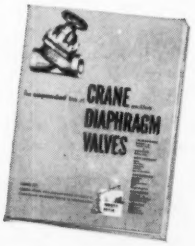


How they solved valve failure on air service

This case history from Willamette Iron & Steel Co., Portland, Ore., shows how you can cut compressed air handling costs in your own plant.

These Crane packless diaphragm valves are handling 100 psi. air on manifolds to distribution lines used aboard ship during construction. Before installing the Crane ¾-inch No. 1610 valves, the yard was troubled by constantly rising maintenance costs. With the other make valves, diaphragms were rupturing after a short time, requiring continual replacement. Loss of air and air power for equipment was costly.

Crane packless diaphragm valves were installed because their neoprene diaphragm functions only as a bonnet seal, and is not subjected to crushing and wear when used as a seating member. The maintenance problem was effectively solved, as it is for so many users throughout industry, by installing the right Crane valve. Contact your Crane Representative today—ask him for complete information on any application.



ASK FOR Crane Folder AD-1942 on packless diaphragm valves. Contact your Crane Representative for a copy, or write to Crane Co., at address below.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

speaking of **Power**

Tomorrow begins today: a philosophy for successful growth

When U.S. Rubber's president, H E Humphreys Jr, recently addressed the press at a luncheon tied in with cutting-the-ribbon on the company's new research center in Wayne, N. J., he made two points crystal clear. First, in recognition of the important role research and development play in U.S. Rubber's successful competition, they are planning an R & D investment of at least $120 million over the next five years. Second, Humphreys and his top staffers are of one mind on the fundamental soundness in thought behind their current research slogan, *Tomorrow begins today*. This planning-for-growth, if you will, is in general accord with the thinking of top industry men across the country.

Electrical growth, and what to do about it, has been the theme of POWER's PTG editorial program over the past year. Based on the premise that a well-planned industrial electrical system takes into account tomorrow's probable growth, this editorial series will continue to outline the thinking that should go into today's plants to meet tomorrow's loads.

The small plant is all too often a prime example of growing-like-Topsy electrically. Our field travels indicate planning in this area carries little of the look-ahead characteristic so necessary if industry is to meet electrical growth needs in a way that is sound from both engineering and straight dollar-investment angles.

To lay down a typical growth pattern for the smaller plant, GE's Don Beeman, an acknowledged authority in the industrial electrical field (also editor of the *Industrial Power Systems Handbook*), outlines general steps a small plant should follow in growing up electrically (p 90, this issue). True, the precise design will vary with each plant but, as indicated by Beeman, there is a common thread that should run through the planning of each small industrial scheme.

***Power* staffers** saw an illustration of the same look-ahead philosophy within their publishing family. While the 75th anniversary issue was rolling off the binding machines and into mailing envelopes, the not totally unexpected announcement came through boosting Lou Rowley to the post of Publisher and Editor. Shelton Fisher, who as Publisher, guided POWER's general economic well being to new heights, remains as Publisher of *Fleet Owner* and *Electrical Merchandising*. Rowley takes his place at the publishing helm of POWER at a most important time in view of the growth years ahead.

Marmaduke Surfaceblow is coming up for his 10th anniversary with the bowing in of the new year. So, perhaps in anticipation of that event, the old buzzard has dredged up from his mental files of engineering events, a yarn that bids for top off-beat honors. In the November issue the hard-fisted consulting engineer of sorts works out a relationship between furnace CO_2 readings and the fullness of the moon.

The story rings in a crystal ball, the customary opponent to the Marmaduke approach to engineering, and a wager that quite naturally ends up in the old-salt's pocket. Like all Marmaduke yarns, the underlying engineering is sound, even though the nature of the route taken to ultimate success is a far cry from procedures taught in any engineering school. You'll agree that the old master in the broad field of applied engineering pulls out all conventional stops next month.

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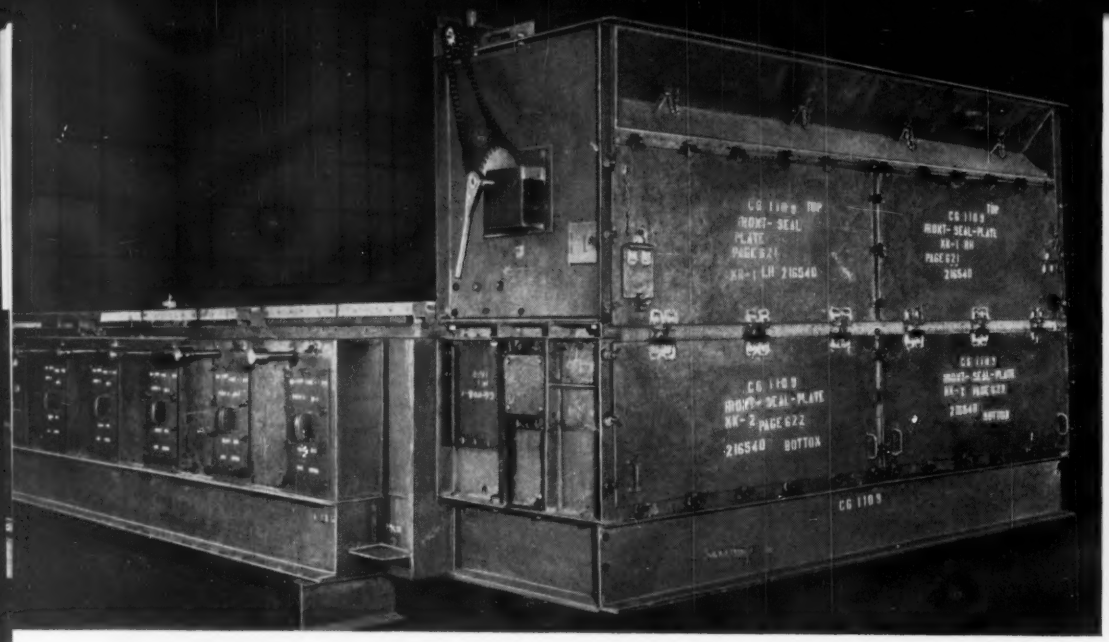
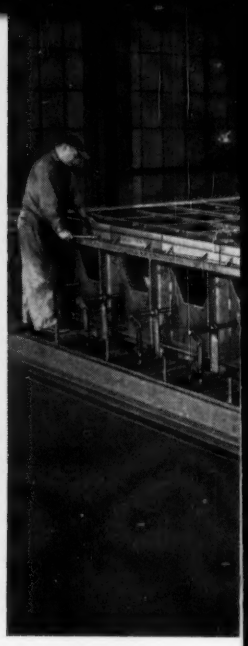
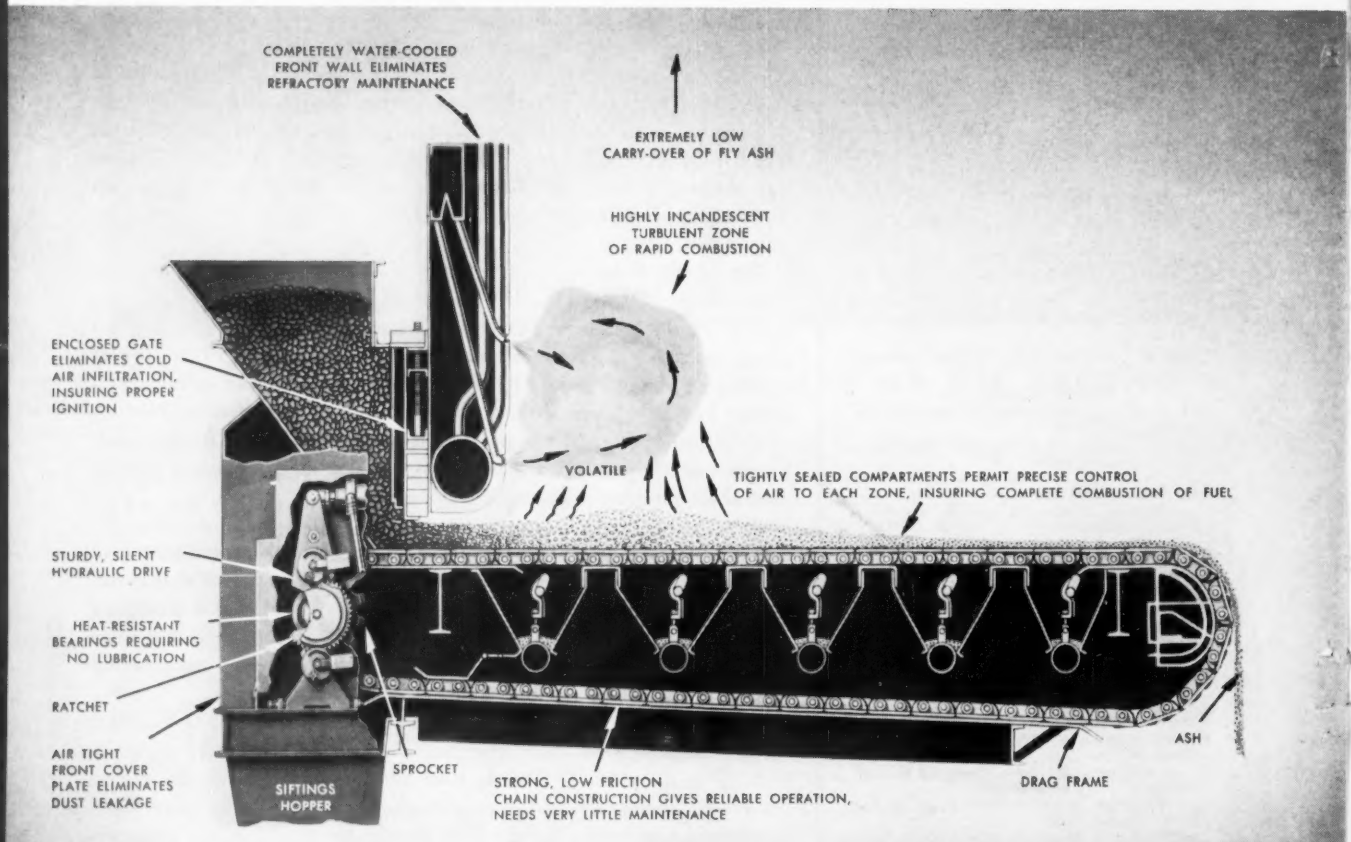


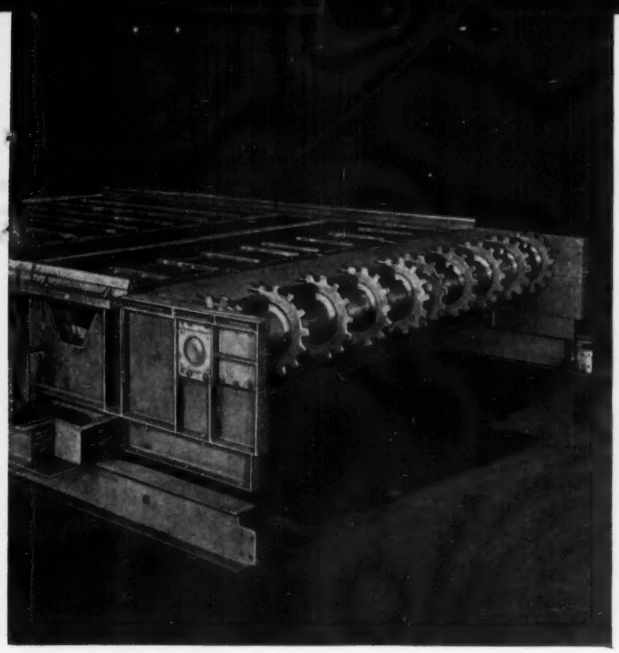


Front of unit is air and dust-tight, maintaining a clean stoker area. Note front seal plates.

B&W Jet-Ignition Stoker Selected


COMPLETELY WATER-COOLED FRONT WALL ELIMINATES REFRACTORY MAINTENANCE
EXTREMELY LOW CARRY-OVER OF FLY ASH
HIGHLY INCANDESCENT TURBULENT ZONE OF RAPID COMBUSTION
ENCLOSED GATE ELIMINATES COLD AIR INFILTRATION, INSURING PROPER IGNITION
VOLATILE
TIGHTLY SEALED COMPARTMENTS PERMIT PRECISE CONTROL OF AIR TO EACH ZONE, INSURING COMPLETE COMBUSTION OF FUEL
STURDY, SILENT HYDRAULIC DRIVE
HEAT-RESISTANT BEARINGS REQUIRING NO LUBRICATION
RATCHET
AIR TIGHT FRONT COVER PLATE ELIMINATES DUST LEAKAGE
SIFTINGS HOPPER
SPROCKET
STRONG, LOW FRICTION CHAIN CONSTRUCTION GIVES RELIABLE OPERATION, NEEDS VERY LITTLE MAINTENANCE
ASH
DRAG FRAME

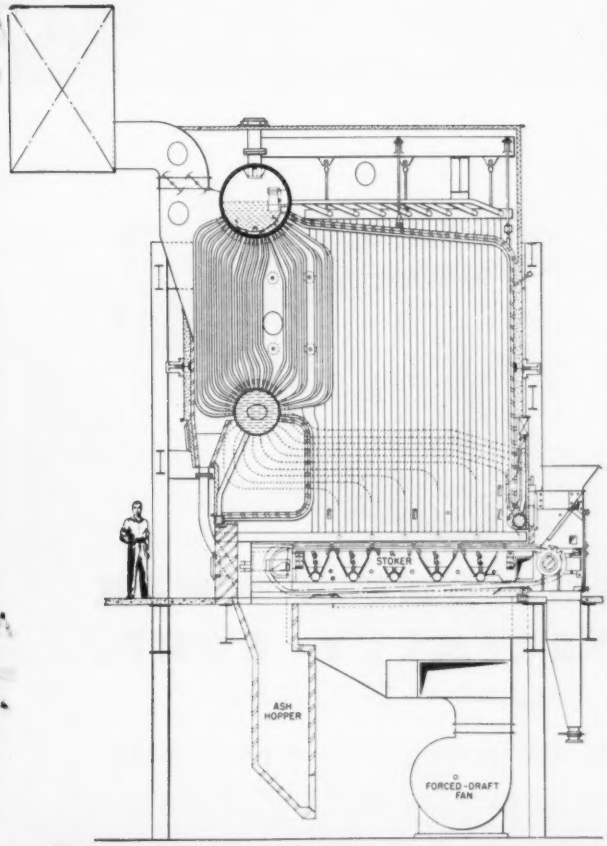
This is Jet-Ignition: Volatile matter, distilled off as coal enters furnace, is immediately mixed with high pressure air. Turbulence insures rapid combustion, radiates heat down on incoming fuel. Gate is completely enclosed, assuring ignition stability. Inspection is easy, maintenance low.



Jet-Ignition Stoker is designed on the chain-grate principle. It has simple, compact hydraulic drive.

Latest Unit at University of Rochester Will Burn High-Caking Coals

to Solve Smoke and Fly Ash Problems



B&W Stirling Boiler with Jet-Ignition Stoker at University of Rochester, designed for 100,000 lbs of steam per hr at 125 psi.

Stable, efficient combustion over wide load ranges, without smoke and with extremely low fly ash, is achieved by the new B&W Jet-Ignition Stoker when burning bituminous and sub-bituminous coals—including high-caking and coking grades. The Jet-Ignition Stoker maintains a clean stack without using dust collectors.

Selection of a B&W Jet-Ignition Stoker for the University of Rochester was made to solve a community relations problem caused by smoke and fly ash. Dr. Lewis D. Conta, Chairman of the University's Division of Engineering, and George D. Haas, Chief Engineer, recommended installation of the unit after observing a commercial installation burning the high-caking coals used by the University.

B&W Jet-Ignition Stokers are another of the developments of B&W engineering and research, supported by nearly a century of experience in all phases of steam generation. If your problem is one of excessive smoking and fly ash emission, Bulletin G-85 will tell you how a B&W Jet-Ignition Stoker can help you. And for any problem in steam generation, B&W engineers are ready to help you and your engineers find the solution. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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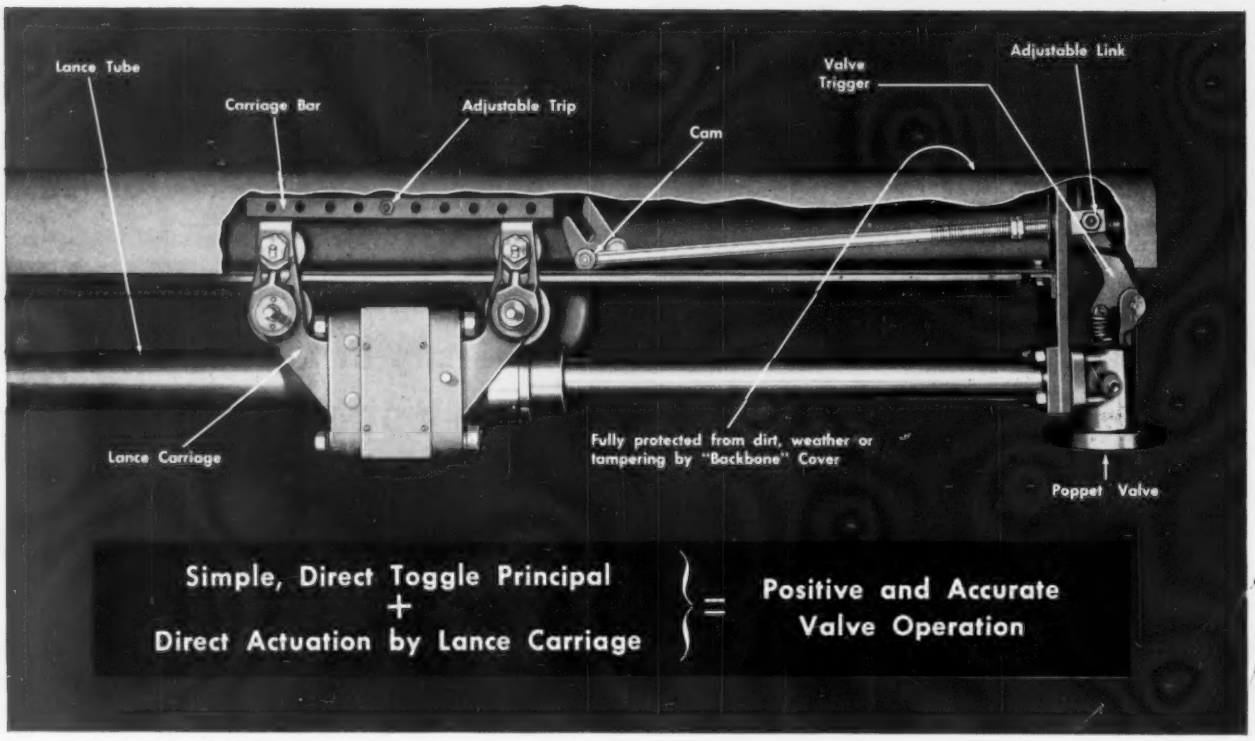
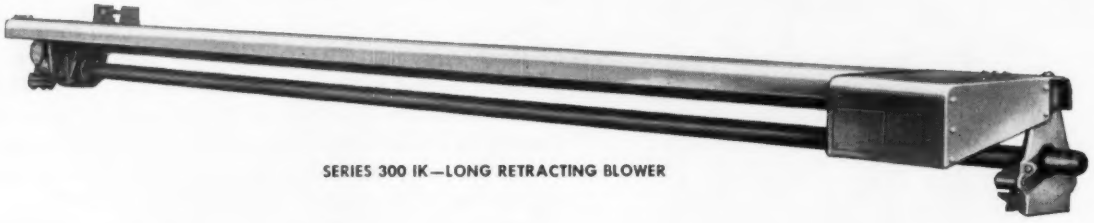
BABCOCK & WILCOX

BOILER DIVISION

MECHANICALLY OPERATED





SERIES 300 IK—LONG RETRACTING BLOWER

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Compact, Accessible Electric Power and Control Terminal Facilities
- Front End Single-Motor Drive
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Diamond Specialty Limited, Windsor, Ontario

POPPET TYPE VALVE

(WITH ADJUSTABLE PRESSURE CONTROL)

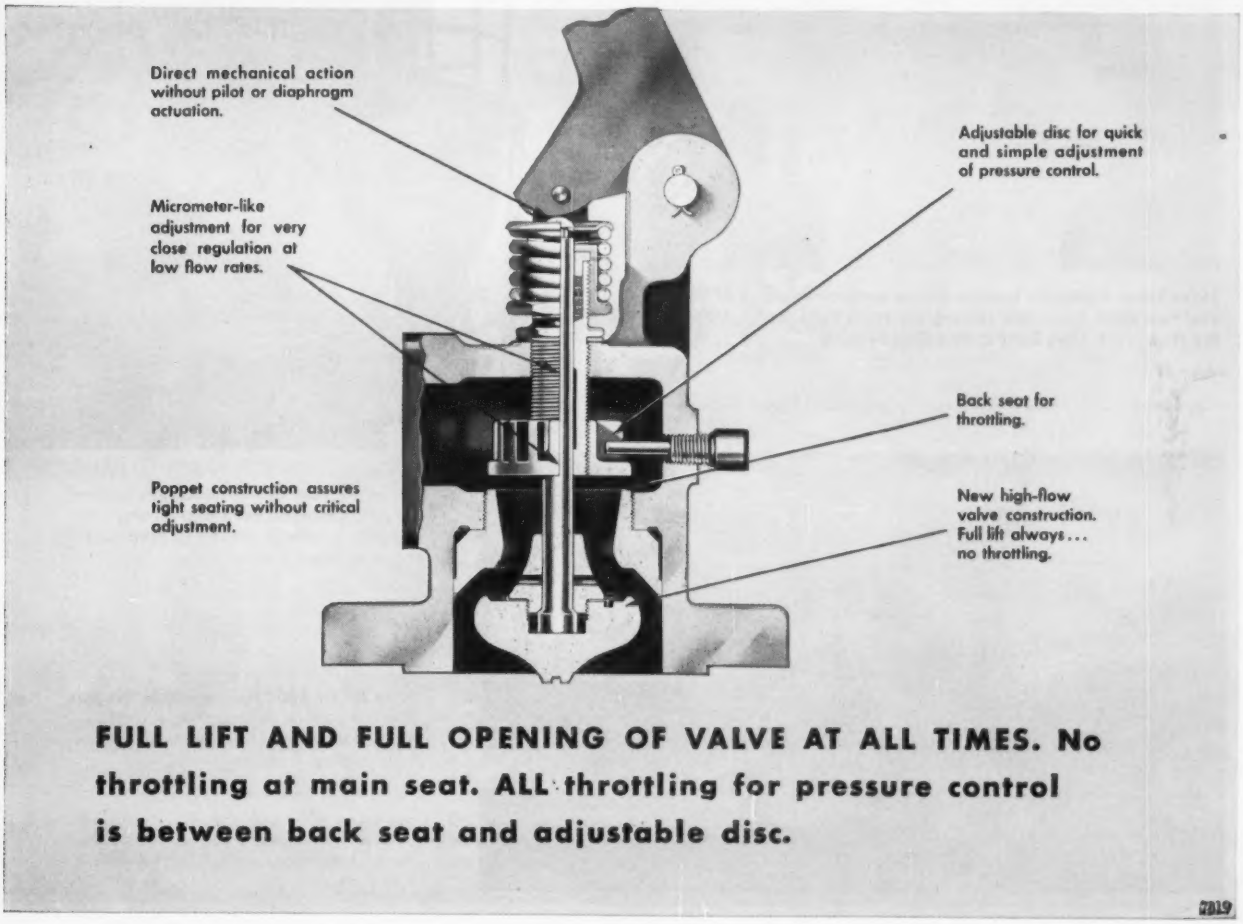
additional important features of the

New Diamond Series 300 IK
LONG RETRACTING BLOWER

This valve was adopted for the new Series 300 IK because long experience has proved it the most satisfactory of all designs for severe blower service. More than 300,000 of this basic design are in use on various Diamond Blowers and have established notable service records. A recent improvement is more streamlined flow contours that permit higher flow rates with less pressure drop.

The direct mechanical linkage for actuating the valve offers the advantages of greater reliability and safety . . . in addition to more accurate control. Numerous other important features of the Series 300 IK are listed at the bottom of the left hand page. These are the reasons why this blower is establishing a new standard of efficiency, economy and dependability in cleaning heating surfaces that require a long retracting blower.

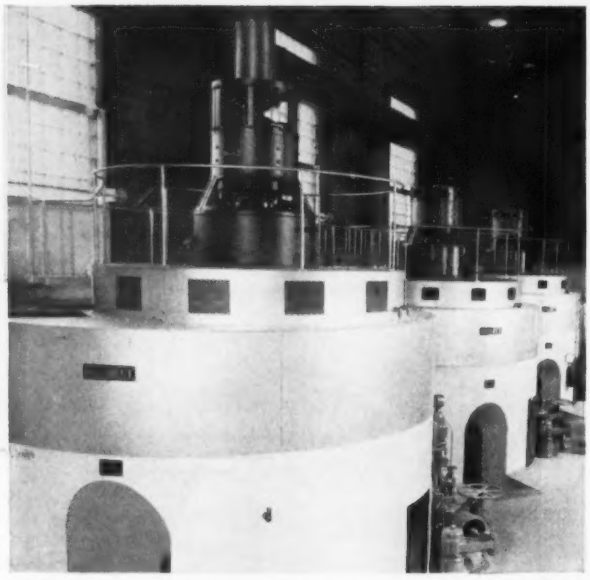
Bulletin 2111U tells much more about the Series 300 IK; ask your local Diamond office or write directly to Lancaster for a copy.


Direct mechanical action without pilot or diaphragm actuation.
Micrometer-like adjustment for very close regulation at low flow rates.
Poppet construction assures tight seating without critical adjustment.
Adjustable disc for quick and simple adjustment of pressure control.
Back seat for throttling.
New high-flow valve construction. Full lift always... no throttling.

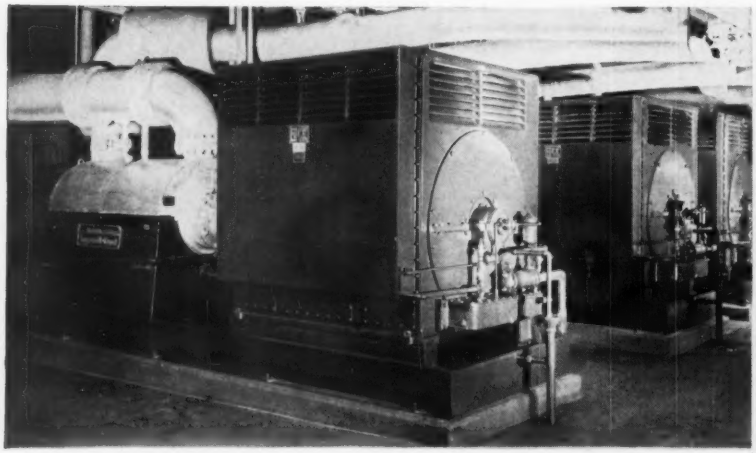
FULL LIFT AND FULL OPENING OF VALVE AT ALL TIMES. No throttling at main seat. ALL throttling for pressure control is between back seat and adjustable disc.

7B19

Once Again . . .
ELLIOTT
equipment was selected

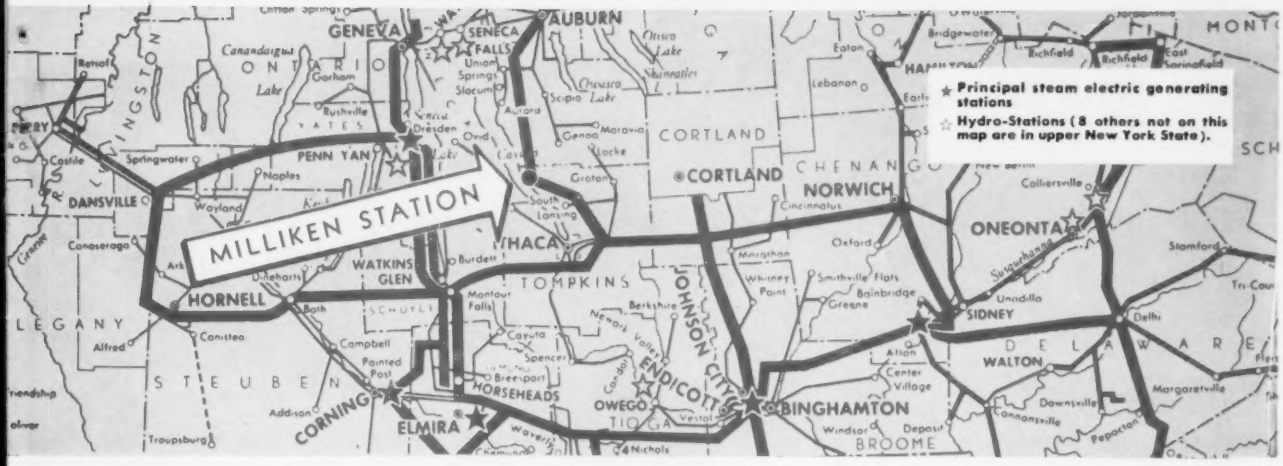


Three Elliott hydraulic turbine-driven generators—one 8750 kva, and two 5000 kva—are serving the High Falls Hydro Station of the New York State Electric and Gas system.



The two Elliott 350-hp, 300-rpm vertical induction motors, seen above, drive the circulating pumps handling lake water at the Milliken Station.

Three Elliott 2000-hp, two-pole "super-quiet" induction motors, left, are driving the Milliken Station boiler-feed pumps.



Elliott Motors, Motor-Generators, Deaerating Heaters, Condensers and Twin Strainers have been used in various stations of New York State Electric & Gas System for many years.

Now, Elliott equipment is serving the Milliken Station

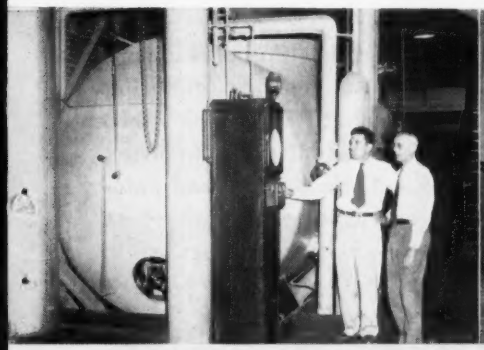
Back in 1852, eight men subscribed $75,000 as initial capital to incorporate a gas light company in Ithaca, New York. Today, as the New York State Electric & Gas Corporation, this aggressive company has more than 15,000 stockholders and a capital investment of over $330,000,000. Before the new Milliken Station was added last year, there were already five principal steam electric generating stations and 13 hydro-stations and the company was serving 35 per cent of the New York State area.

Selecting dependable steam and electrical equipment for an expanding organization of this type is vitally important. In this case, Elliott products previously installed in the company's various stations had already proven their dependability. Once again Elliott equipment was selected. The same thing has happened all over the country—again and again, *consistent, trouble-free performance has led to repeat orders.* For descriptive literature, call your nearest Elliott District Office or write Elliott Company, Jeannette, Pa.

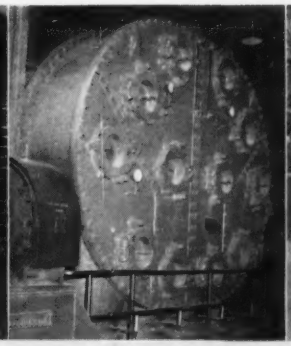
ELLIOTT Company

Steam Turbines • Motors • Generators • Deaerating Heaters • Ejectors • Condensers • Centrifugal Compressors • Turbochargers • Tube Cleaners • Strainers

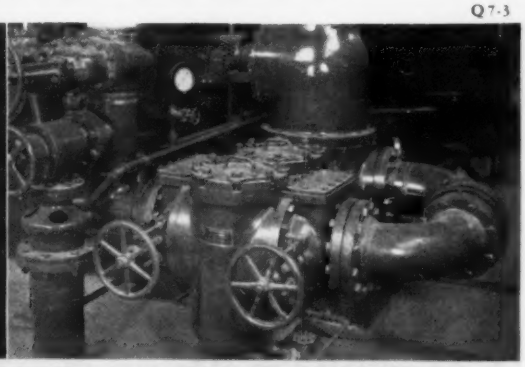
Q7-3



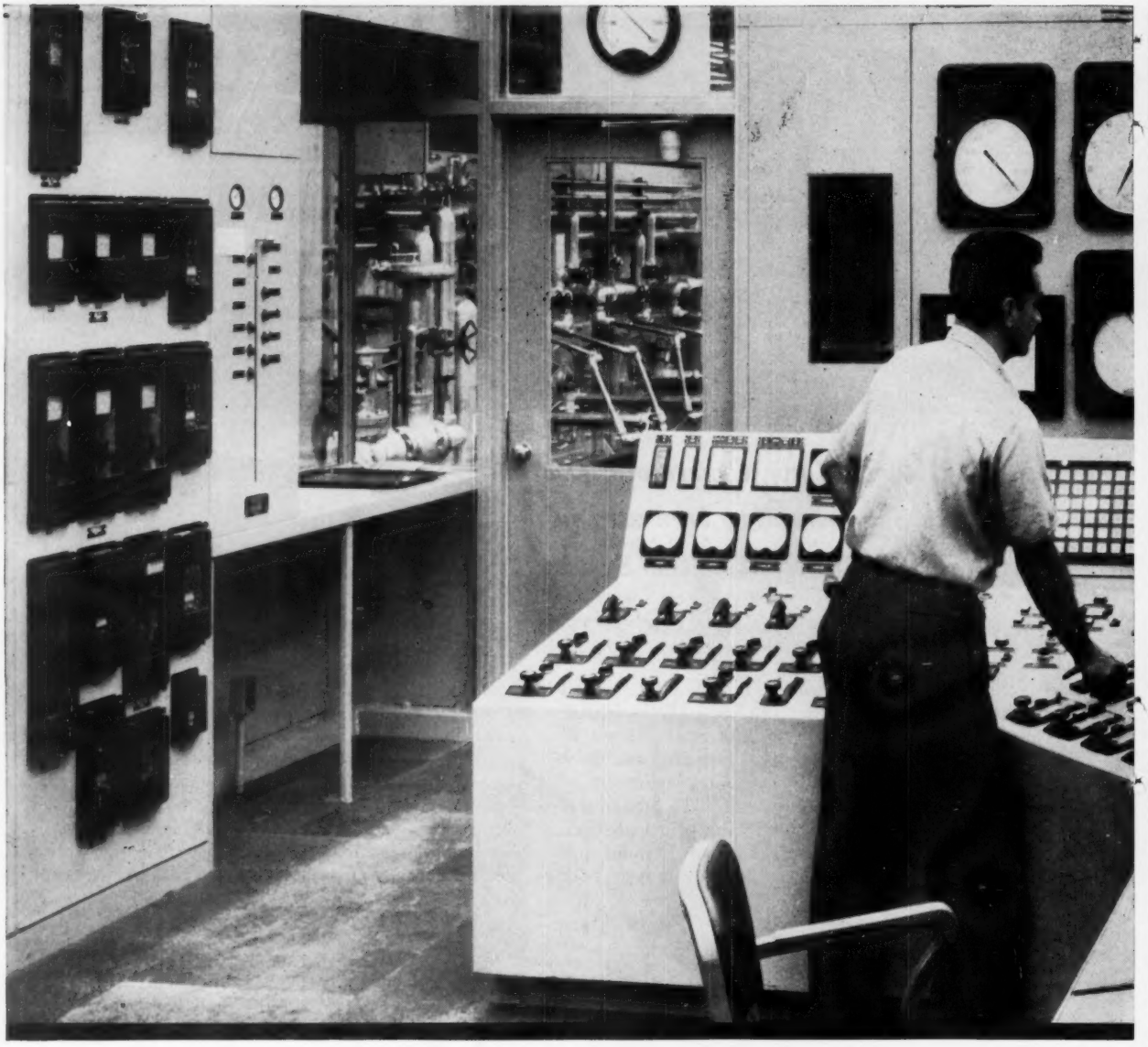
An Elliott 210,000-lb-per-hr deaerating heater in the Greenridge Station, which has a vertical heater mounted on top of a horizontal storage tank.



An Elliott 27,000-sq ft divided water-box surface condenser, seen above, serves the No. 7 turbine in the Goudey Station.



Installed in the suction line to a gasoline-engine-driven fire pump at Milliken is this Elliott 8-in. twin strainer.



How Bailey stretches

You can wring more energy out of a dollar's worth of fuel when you are getting optimum performance from your steam plant equipment. You get peak performance when Bailey Meters and Controls are on the job. They increase your plant efficiency.

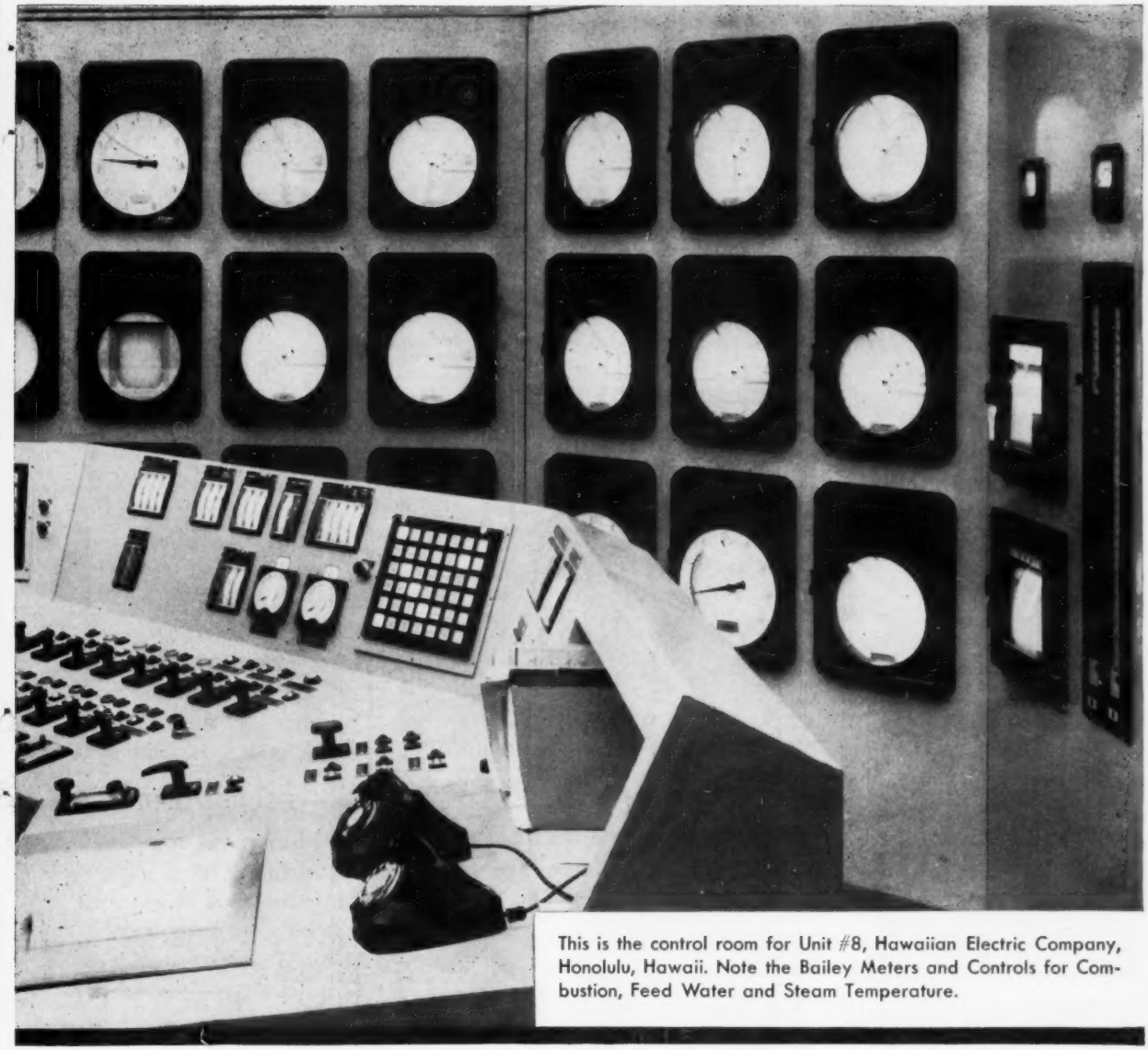
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



This is the control room for Unit #8, Hawaiian Electric Company, Honolulu, Hawaii. Note the Bailey Meters and Controls for Combustion, Feed Water and Steam Temperature.

your fuel dollar

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

AI32-2

BAILEY METERS

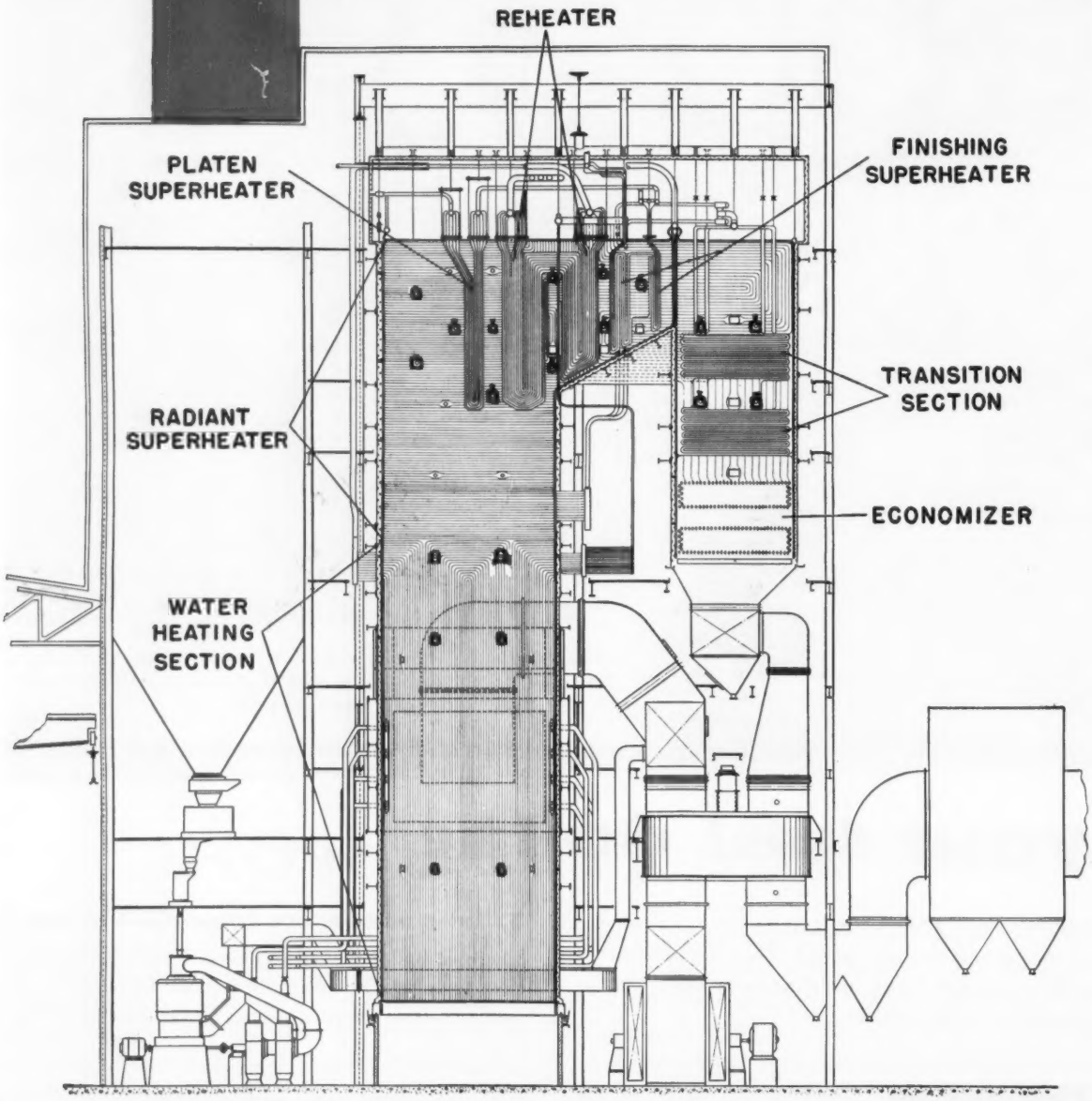
Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

Vulcan Selective-Sequence System picked for



The Cleveland Electric Illuminating Company
Avon Station Turbine Unit #8—Boiler #11
CE Sulzer Design
Boiler Capacity—1,715,000 lbs. per hour
Turbine Capability—250,000 KW
Steam Conditions at Turbine Throttle—3500 PSIG—1100F—1050F

Soot Blowing Avon Station

The Cleveland Electric Illuminating's new super-critical pressure unit at Avon Station will be equipped with Vulcan T-3-E long retractable soot blowers, RW-3E wall deslaggers and air-preheater cleaning controls. Blowing medium will be air with emergency steam stand-by—from existing boilers. Air will be furnished by a centrifugal air compressor. Selective-sequence control will provide precisely the sequence necessary for the most effective cleaning. Blowing sequences can be varied from a compact, pre-wired control board simply by means of patch cords. Thus, any blower can be operated at any point in the sequence. The entire cycle can be set to run automatically to completion, to recycle or to operate under clock control.

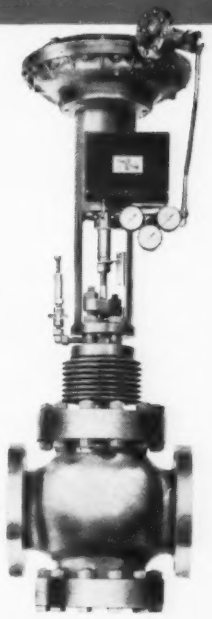
Modern Copes-Vulcan soot blowing systems such as the selective-sequence to be installed at Avon Station can help to keep your boilers operating at peak efficiency. Your Copes-Vulcan representative has the ideas, information and experience to help you make the selection best suited to your operation.

COPES VULCAN

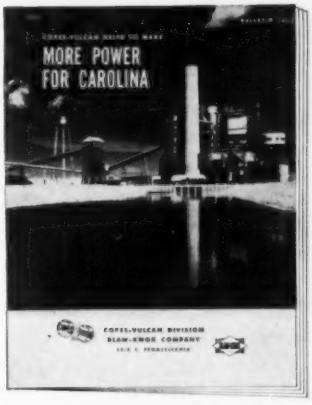
BLAW-KNOX

COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA

C-V NEWS NOTES

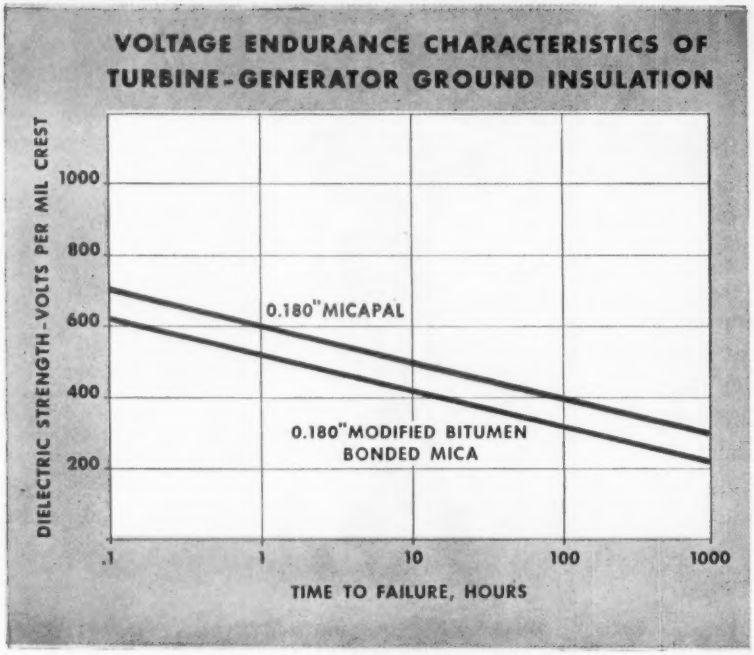


New Copes-Vulcan diaphragm-type CV-D valves have high rangeability, are either reverse or direct acting. They can be applied in sizes up to 12 inches at unlimited pressures.

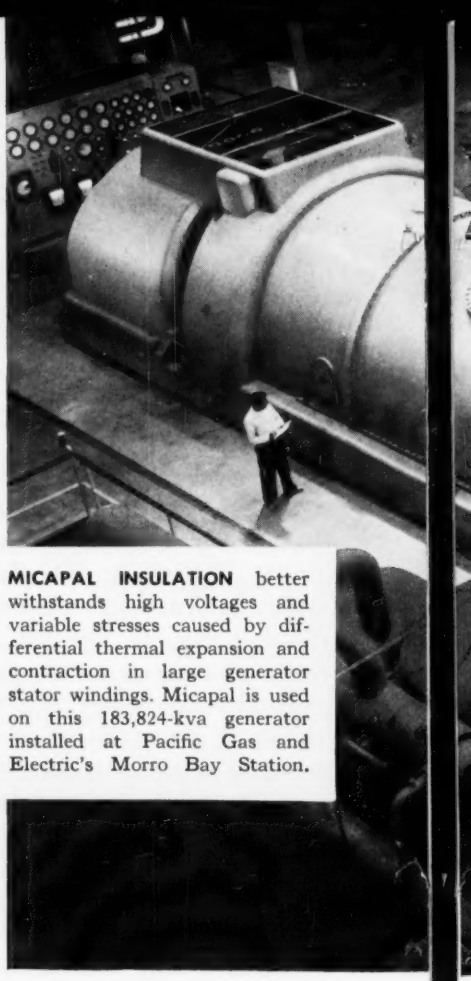


Copes-Vulcan boiler control at Louis V. Sutton Steam Electric Generating Plant of Carolina Power & Light Company is described in Bulletin 1032. Your Copes-Vulcan man has a copy for you, or you may wish to write direct.

Unit 8 at Avon Station will get Copes-Vulcan pressure reducing and desuperheating station for energizing back-up soot blower steam supply. Copes-Vulcan desuperheaters will provide close control for all loads from 0 to 45,000 pounds per hour, with virtually instantaneous cycling.

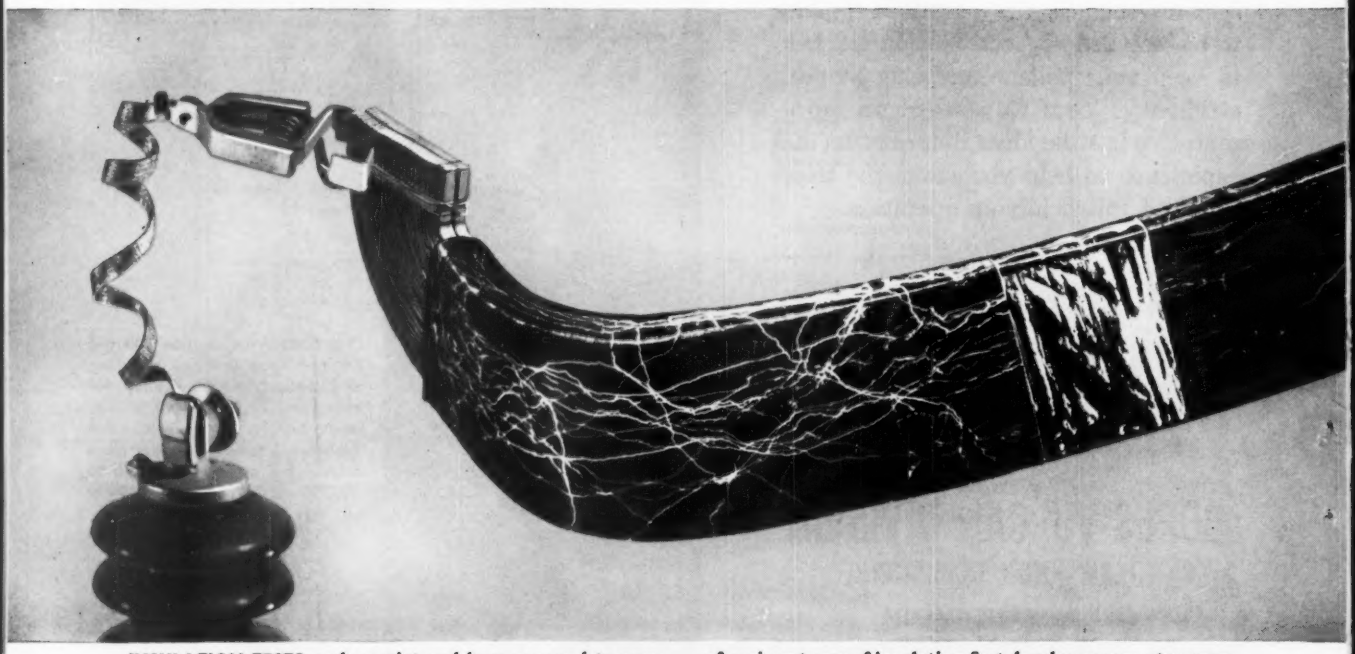


SIGNIFICANT IMPROVEMENT is noted in voltage endurance obtained for any duration of voltage application on Micapal compared to presently accepted generator insulating material. This improved voltage endurance increases long-term turbine-generator availability.

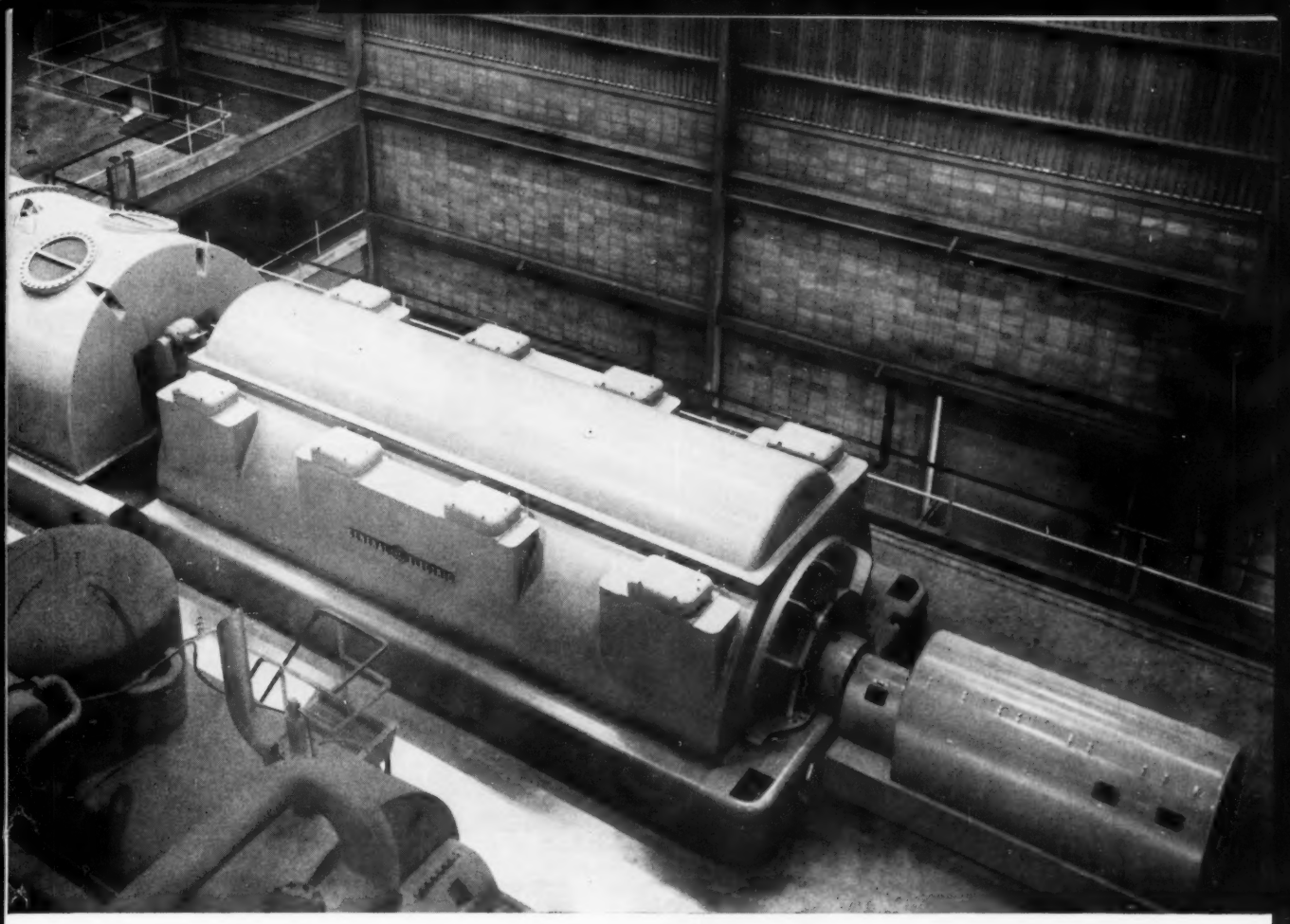


MICAPAL INSULATION better withstands high voltages and variable stresses caused by differential thermal expansion and contraction in large generator stator windings. Micapal is used on this 183,824-kva generator installed at Pacific Gas and Electric's Morro Bay Station.

How General Electric Micapal



INSULATION TESTS such as pictured here are used to compare the dielectric breakdown of different insulations. Forced to carry voltages far above their rating, test bars of various types of insulation first develop corona streamers, then finally fail, enabling engineers to measure the insulation's actual voltage endurance.



insulation extends generator life

IMPROVED INSULATION BETTER WITHSTANDS HIGH VOLTAGES, VARIABLE STRESSES

Now, after extensive research and four years of operating experience, General Electric announces the extended application of Micapal insulation for high-voltage stator windings. A major advance in providing still longer, more reliable operation, this mica-based insulation offers these distinct advantages:

Greater Tensile Strength. Micapal incorporates mica mat and some mica flake bonded with a duplex thermosetting resin. Mica mat is finely divided, reconstituted mica formed into sheets. The thermosetting binder, combined with uniform mica structure, makes Micapal much tougher at operating temperatures than earlier insulations.

Greater Dimensional Stability. Micapal is molded to the precise shape of generator armature bars. Because of thermosetting qualities, the insulation won't flow or lose shape. It possesses great mechanical strength over the full range of operating temperatures.

Improved Thermal Conductivity. Micapal removes heat from electrical conductors more easily. The result is that for a given current and same insulation thickness, the armature bar runs cooler.

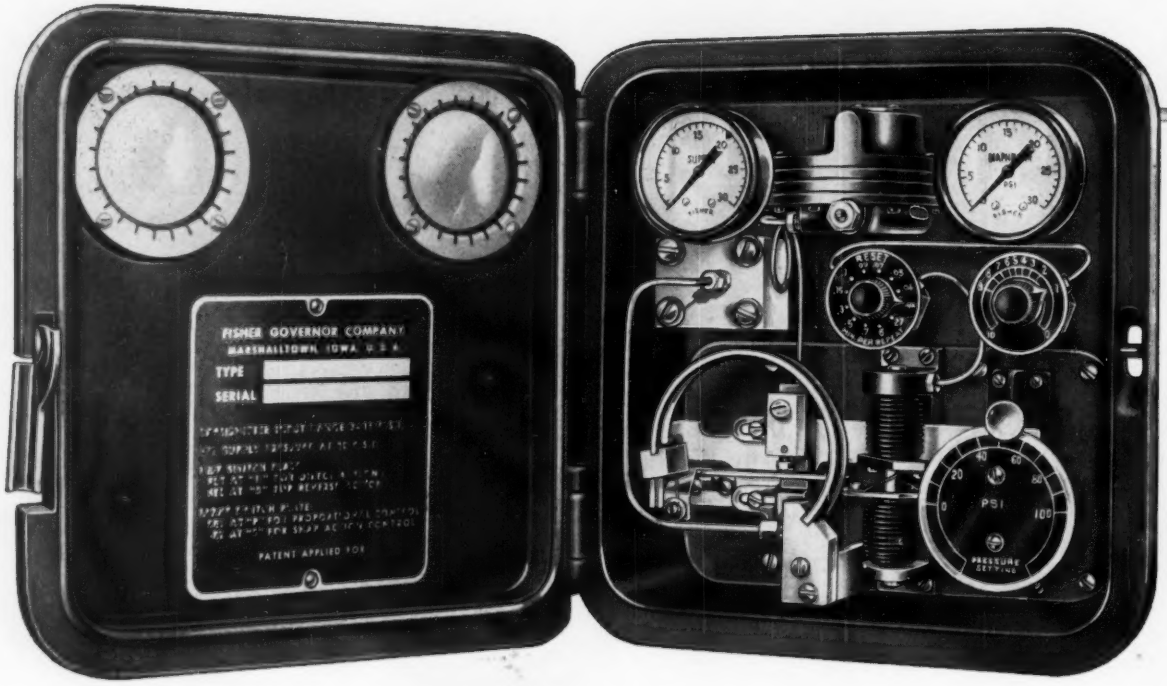
Improved Dielectric Breakdown Strength. The voltage endurance characteristics shown on the chart, above, illustrate how Micapal insulation withstands a much higher voltage than other mica insulation for any given period of time. The impulse puncture structure of Micapal has been shown by laboratory tests to be higher by an even greater factor.

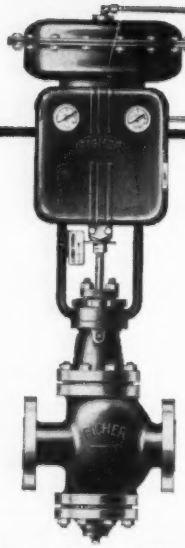
Improved Micapal insulation is just another example of General Electric steam turbine-generator progress in meeting tomorrow's power demands. For more information on new generator developments, write Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York.

254-41

Progress Is Our Most Important Product

GENERAL ELECTRIC

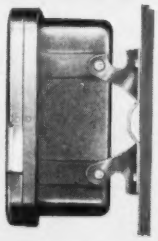




Any of the Wizard controllers can be yoke mounted on a diaphragm control valve to make a compact pilot operated pressure regulator as shown above. All Wizards are normally supplied with an operating medium air set which filters and reduces supply pressure of 25 to 250 psi to constant pressure of 20 psi for 3 to 15 psi, or 35 psi for 6 to 30 psi operation.

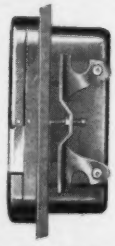
SURFACE MOUNTING

The Wizard can be mounted on the surface of a wall or any stable surface. A special mounting bracket is provided and any type of screw or bolt suitable for the mounting surface may be used.



FLUSH MOUNTING

By turning the bracket around that is provided for surface mounting, any Wizard can be mounted flush to a panel.



WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

For closer control in today's more complex processing industries

FISHER®

WIZARD II PRESSURE CONTROLLER

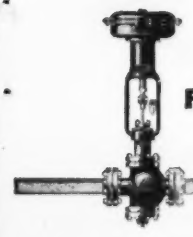
For over a quarter century, the name "Wizard" has become a byword as the pressure controller that is accurate, dependable and simple to operate in all types of industry.

Now, the WIZARD II takes over to meet the demands of modern, complex control systems requiring closer control. The WIZARD II retains all of the basic simplicity, accuracy and dependability of the Wizard 4100U, plus a number of new components. The WIZARD II is in a waterproof aluminum die-cast case and cover with ¼" tapped vent for gas service. With the addition of a few parts, the basic proportional controller can be converted to: (1) two-position action or "Snap Action", (2) pressure transmitter, (3) controller with remote set adjustment, (4) proportional plus reset response. The WIZARD II can be changed from direct to reverse action or vice versa without additional parts.

The superior subassembly construction stresses simplicity and compactness. Each subassembly is assembled and calibrated prior to mounting in the case. All Series 4150 Wizards can be supplied for remote set adjustment for changing the pressure setting from a location away from the Wizard controller.

Careful and exhaustive tests have conclusively proved that the WIZARD II measures up to the rigid Fisher standards.

A completely descriptive and illustrated bulletin on the WIZARD II is yours for the asking. Write today for Bulletin No. D-4150.



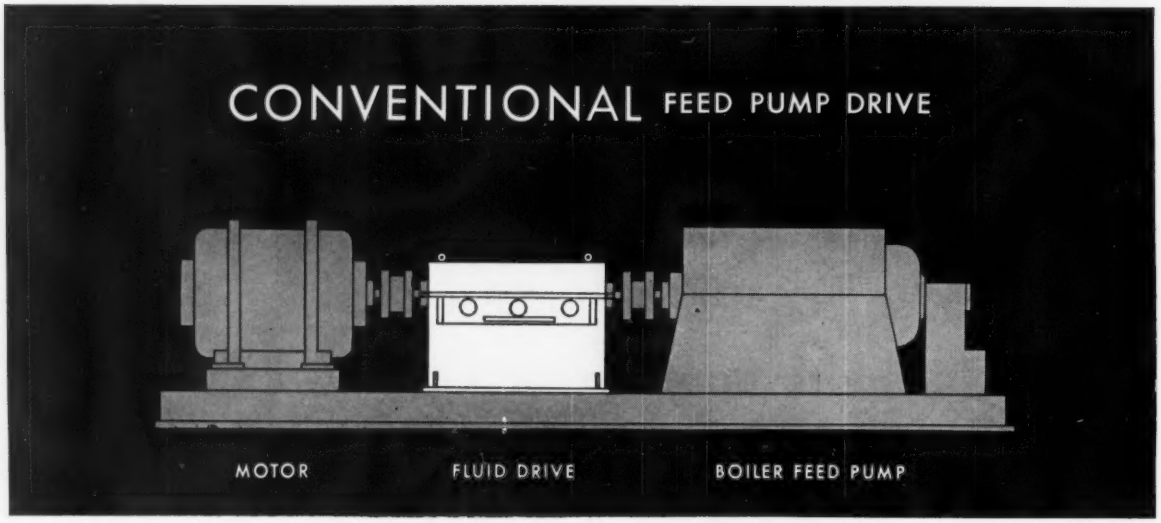
FISHER GOVERNOR COMPANY

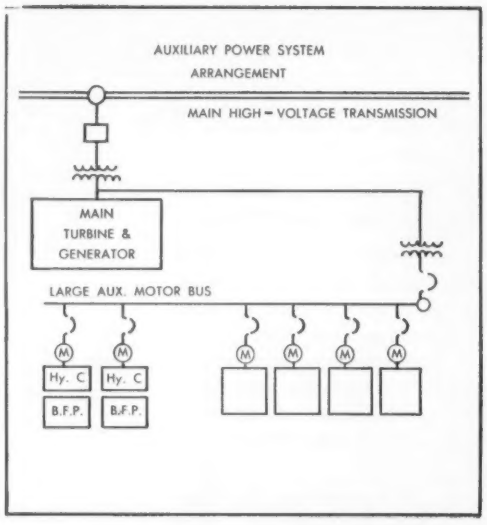
Marshalltown, Iowa / Woodstock, Ontario

FISHER® Controls

SINCE 1880

How *Gýrol*® Fluid Drive meets all

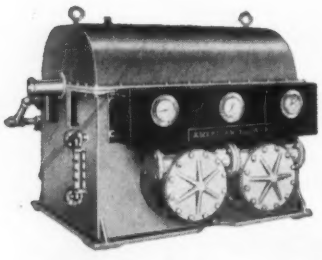




Of all power-plant auxiliaries, the boiler feed pump consumes the greatest single segment of invested power. To release more of this power to consumer lines, power plants of all sizes are controlling feed water flow by speed regulation through Gýrol Fluid Drive – driven by a constant speed prime mover.

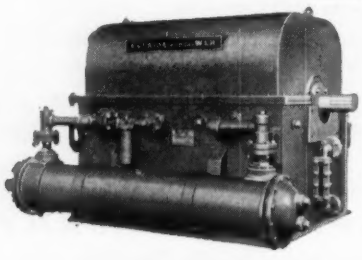
Gýrol Fluid Drive offers several specific advantages:

1. It saves power over the entire operating range by eliminating wasteful throttling by valves.
2. Fluid Drive's adjustable-speed feature permits reduction in pressure – resulting in further power savings.
3. It reduces wear on bearings, and other vital pump parts, by letting the pump operate at speeds that fit boiler demands.
4. With Fluid Drive, paralleling of pumps is simplified. Change-over from operating to standby pump is quick and easy.
5. Quiet operation is inherent in the design of Fluid Drive, since a "cushion of oil" is the means of energy transmission.



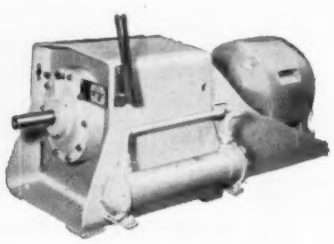
TYPE VS CLASS 6

- adjustable speed control
- 250 to 12,000 horsepower
- speeds to 3600 rpm



TYPE VS CLASS 4

- adjustable speed control
- 100 to 2500 horsepower
- speeds to 1800 rpm

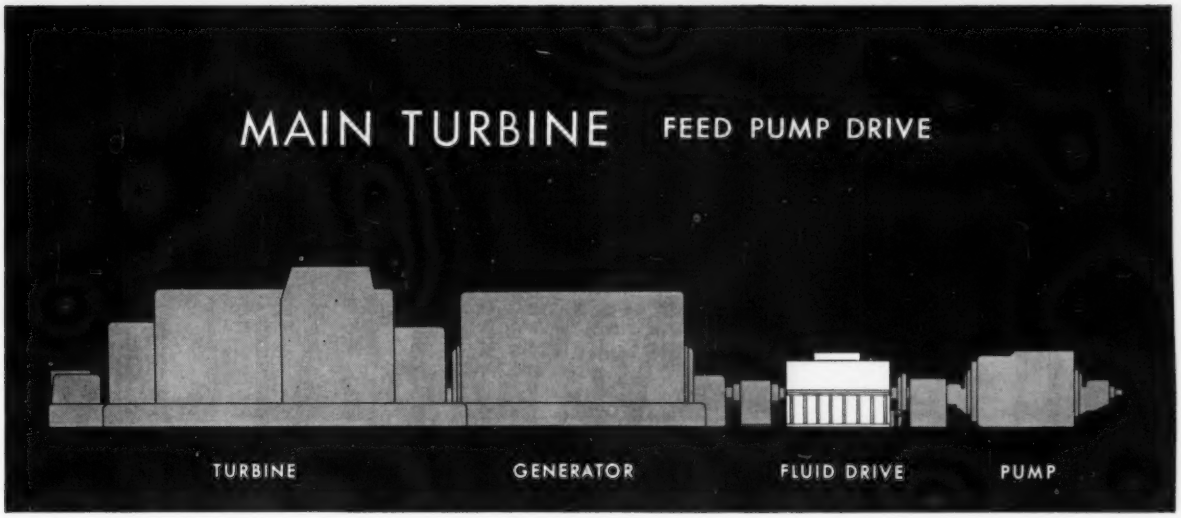


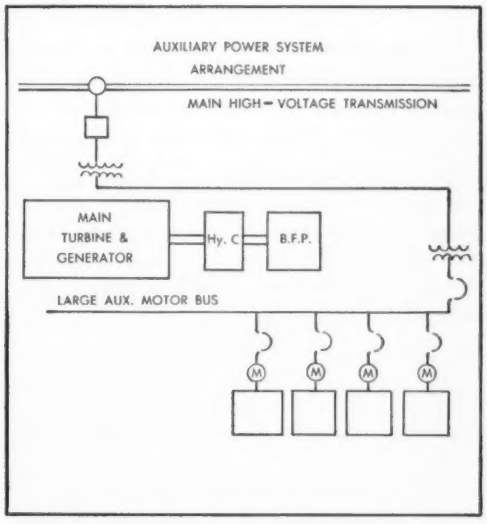
TYPE VS CLASS 2

- adjustable speed control
- 1 to 800 horsepower
- speeds to 1800 rpm

requirements for feed pump control

Regardless of station size, arrangement, or prime mover, you get the advantages of power savings, reduced pressures, and quiet operation with American Blower Gýrol Fluid Drives





Already in the construction stage is the use of Gýrol Fluid Drive for main turbine feed pump drives on some of the largest generating units yet projected.

For example, two of these stations will each drive, through a 12,000-hp adjustable-speed Gýrol Fluid Drive, the main feed pump from the high-pressure turbine. Full boiler capacities will be supplied by the single 5-stage pump, each delivering 6330 gpm against 6400 feet total discharge head when operating at 3510 rpm with feed water at 363° F.

Each pump requires an excess of 11,000 hp, and will be driven from the generator shaft through an adjustable-speed Gýrol Fluid Drive.

In your plans for expansion, why not discuss the advantages of Gýrol Fluid Drive with an American Blower engineer. His knowledge of this application in modern power plants may prove valuable to you. Call our nearest branch, or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

AMERICAN BLOWER

Division of AMERICAN-Standard

THE CROSS COMPANY—Fraser, Michigan
Consulting Engineers, Giffels & Vallet, Detroit, Michigan

Installed at this new ultra-modern plant are two 12-million BTU capacity C-E Hot Water Boilers. When this pioneer producer of automation equipment studied their heating requirements, they calculated that this system would provide the lowest fuel and maintenance costs. Their actual winter operating experience proved the soundness of this decision.

CONVAIR-ASTRONAUTICS—San Diego, California
Consulting Engineers, Pereira & Luckman

When this division of the General Dynamics Corporation determined that more space was needed for their Atlas Intercontinental Ballistic Missile project, this new center for research, development, manufacturing, and primary testing of the Atlas was decided upon. Installed in this center of space flight research will be two 30-million BTU C-E Hot Water Boilers.

HIGH TEMPERATURE

ADVANTAGES

—of high temperature water:

1. Higher available heat—many times that of steam at the same pressure.
2. Closer control of temperature.
3. Lower heat loss . . . unused heat returns to the boiler . . . no condensate return lines.
4. No elaborate feedwater treatment . . . make-up requirements are exceptionally low.
5. Steam traps not required . . . trap problems and expense are eliminated.
6. No blowdown losses . . . no safety valve vent losses . . . no condensate losses.

—of the C-E Hot Water Boiler:

1. Complete control of circulation in system and boiler.
2. No separate boiler pump needed . . . pressure loss is low.
3. Pressurized operation with oil or gas means no induced draft fan.
4. Single-pass design—no baffles—means cleaner boiler and lower draft loss.
5. Controlled, positive circulation permits more efficient arrangement of heating surfaces.
6. Any fuel—oil, gas, coal, or any combination of fuels.
7. Gas-tight, welded steel casing.
8. Fewer headers, all of which are easily accessible.

COMBUSTION

Combustion Engineering Building

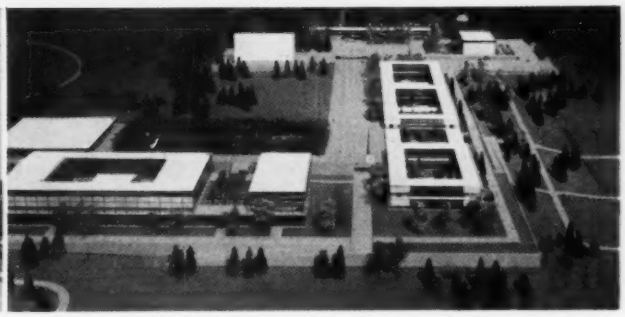
CANADA: COMBUSTION ENGINEERING-

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

RIVERVIEW COMMUNITY HIGH SCHOOL—Riverview, Michigan
Consulting Engineers, Bennett & Straight, Detroit, Michigan

To keep pace with the expanding need for more educational facilities, Riverview, Michigan has recently finished this fine, modern high school. Its heating requirements are met by two 10-million BTU C-E La Mont Controlled Circulation Hot Water Boilers.

U.S. AIR FORCE ACADEMY—Colorado Springs, Colorado
Consulting Engineers, Skidmore, Owing & Merrill



Typical of our Air Force's widespread acceptance of high temperature water for various of their installations is the selection of five C-E Hot Water Boilers for their new academy. These units will furnish heat for living, academic, and service areas here.

WATER today's new idea in large-space heating

In such diverse applications as industrials, large educational institutions, and military bases, high temperature water is finding rapidly increasing acceptance as an ideal means of heating large areas.

A big factor in bringing this trend about is The C-E La Mont Controlled Circulation Hot Water Boiler. Using the same principle as that applied by C-E in many of the country's largest utility boilers, this new boiler provides a degree of temperature control that makes it the most attractive method of heating in many cases. With a wide range of capacities – from 10 to 300 million Btu's – these boilers operate at water pressures up to 500 psi and temperatures to 470F, or higher. Depending upon local conditions, a C-E Hot Water Boiler can save from 10 to 20 per cent in maintenance and operating costs.

The smaller capacity Hot Water Boilers are completely shop assembled, while the intermediate and large units are shipped in varying stages of assembly. This C-E practice greatly reduces erection costs.

So, if you are in the market for boilers, either for space heating or process requirements, it may prove greatly to your advantage to investigate the use of high temperature water as your heat source. Because individual needs vary, both steam and hot water have their place. Our engineers will be pleased to discuss either method with you or your consultants –impartially and with no obligation.

For further details on high temperature water boilers by C-E write for our catalog HCC-2.

ENGINEERING

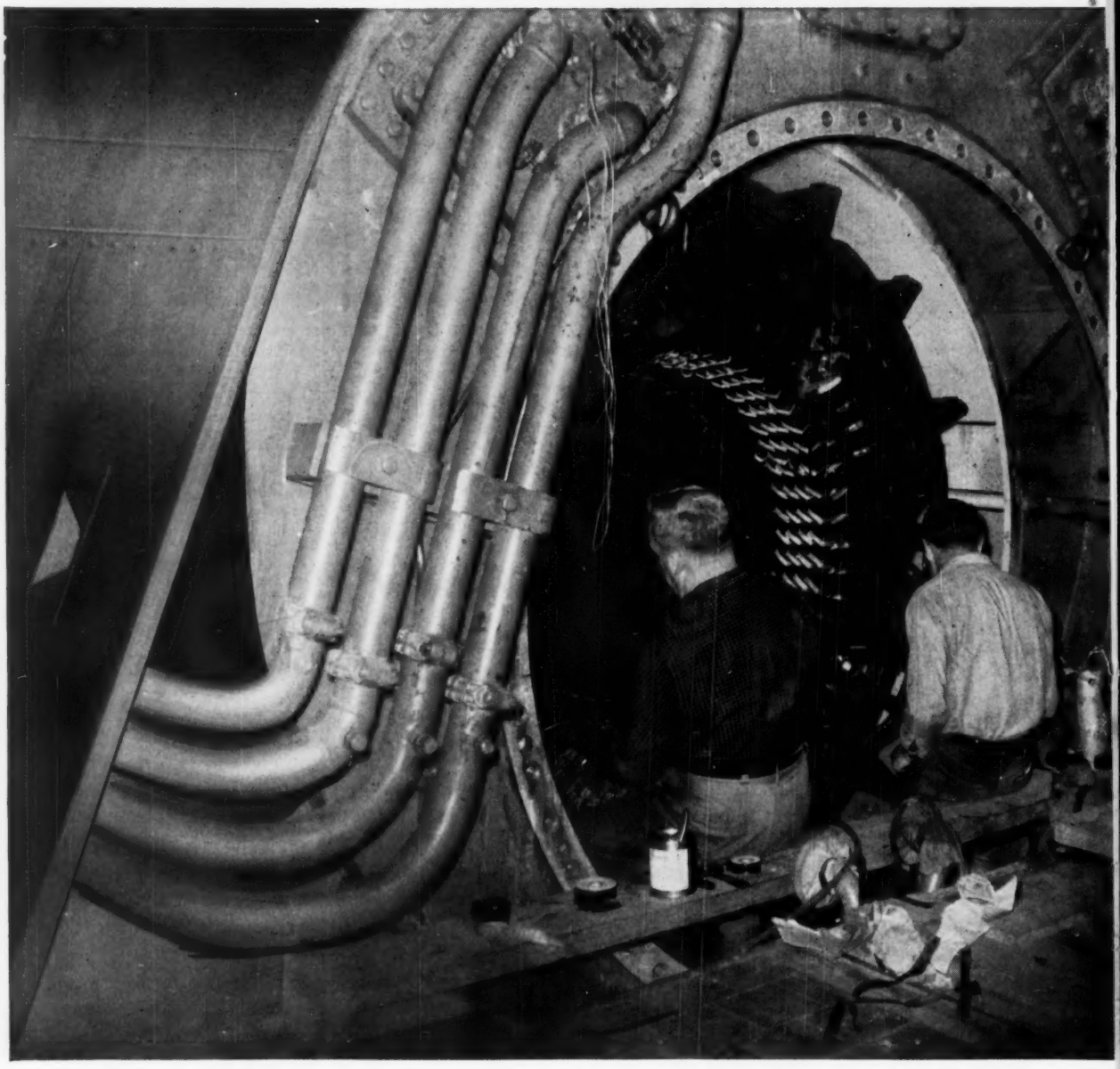
C-E

C-120

200 Madison Avenue, New York 16, N. Y.

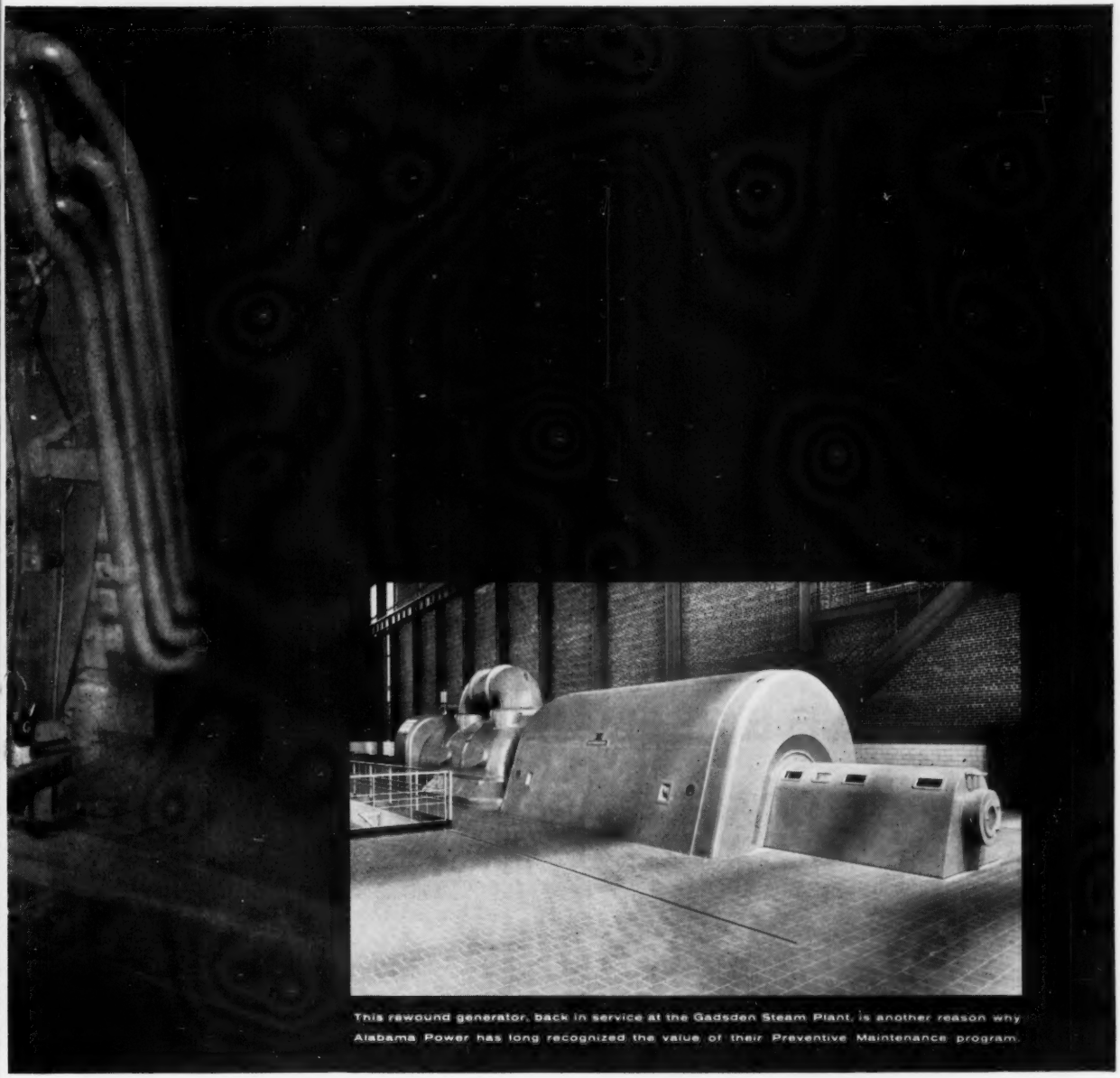
SUPERHEATER LTD.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



Westinghouse Preventive Maintenance at Alabama Power Company

FROM COIL ORDER TO COMPLETED REWIND IN 4 WEEKS



This rewound generator, back in service at the Gadsden Steam Plant, is another reason why Alabama Power has long recognized the value of their Preventive Maintenance program.

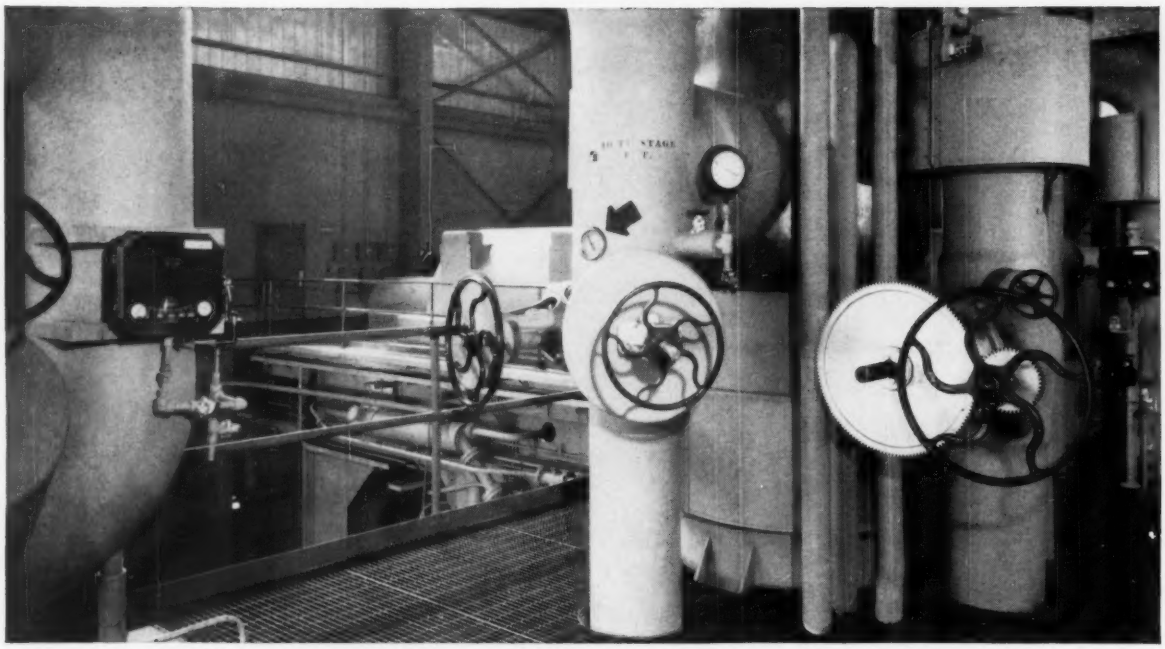
Westinghouse Preventive Maintenance Inspection Service serves Alabama Power Company, again. When Westinghouse field engineers inspected this 60,000-kw generator in February, 1957, during scheduled overhaul of the generating unit, they found conditions which led to a decision to rewind it during the outage then in progress. Westinghouse was ready with men and materials to do the job.

Alabama Power stated the unit couldn't be out of service for more than 5 weeks, or they would suffer additional loss. Westinghouse alerted its personnel, ordered the coils and started working 20 hours a day, 6 days a week, to strip and rewind. The job was completed March 14th, 28 days after the customer order was given.

Skilled, highly trained Westinghouse field personnel will perform preventive maintenance inspection, on-the-spot repairs and modernization to keep your electric apparatus operating at peak efficiency. Nationwide, they are on call 24 hours a day with fast, reliable service.

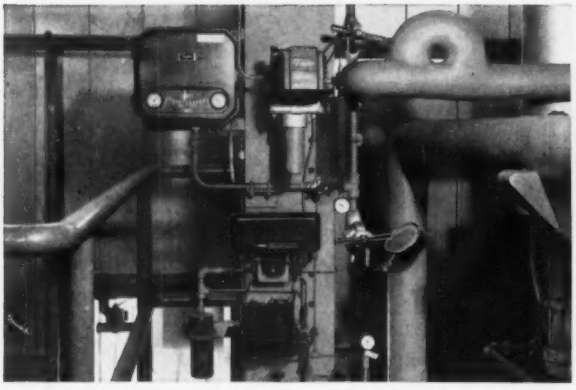
Contact your Westinghouse salesman, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa. J-95183

YOU CAN BE SURE...IF IT'S Westinghouse

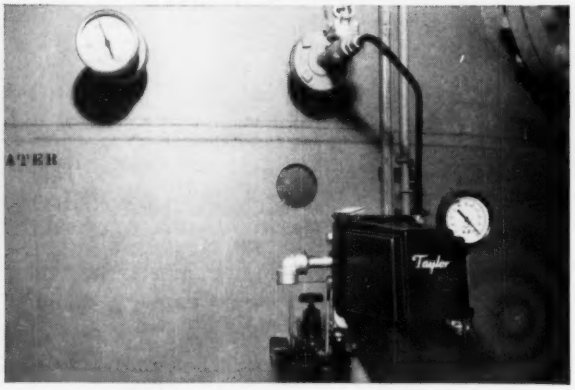


Two Taylor 226RF pressure transmitters are in use here on the feed water heaters in the turbine room of the power plant. A Taylor BI-THERM* dial thermometer is also visible.

DELAWARE POWER AND LIGHT FOR POWER PLANT OF NEW



Part of a two-element boiler control system: 348RF computing relay determines influence of 333RD flow transmitter and a 226RF pressure transmitter on final control. (335RF TRI-ACT* controller.)



This is a Taylor 333RD transmitter measuring liquid level on a soft cooling water storage tank. Also a Taylor BI-THERM dial thermometer.

*Reg. U.S. Pat. Off.

Taylor Instruments

Taylor responsible for critical measurements of temperature, pressure, flow and liquid level.

THE Delaware Power and Light Company picked Taylor instruments to make the highly critical measurements of temperature, pressure, flow and liquid level in their power plant, which supplies power to the Tidewater Oil Company's new refinery near Delaware City. The applications shown here are typical of the important responsibilities given to Taylor instruments.

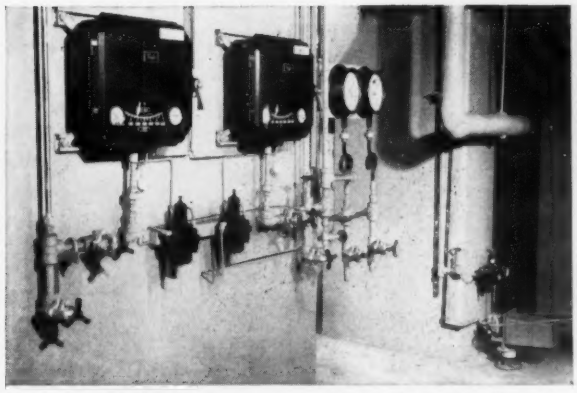
In this power plant, as in the refinery itself, Taylor instruments were specified for measuring these variables because their past performance has shown that they were dependable, rugged and accurate. Delaware Power and Light particularly liked Taylor's transmitters, because of their extreme accuracy in measurement and transmissions, and their reputation of low maintenance.

• • •

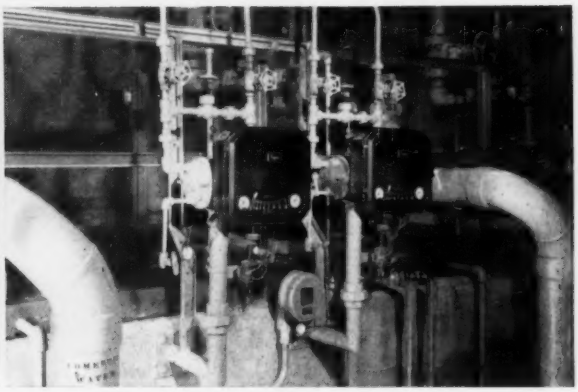
Taylor makes instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

To find out how you can benefit from Taylor instrumentation, call your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

CHOSE *Taylor* INSTRUMENTS TIDEWATER OIL REFINERY !



Here two 226RF steam pressure transmittersare shown in use on the No. 1 and 2 feedwater heaters; a 334RD (lower right) on condenser hot well level.



Here is an application of two Taylor flow transmitters, metering the domestic water flow in the water treatment plant.

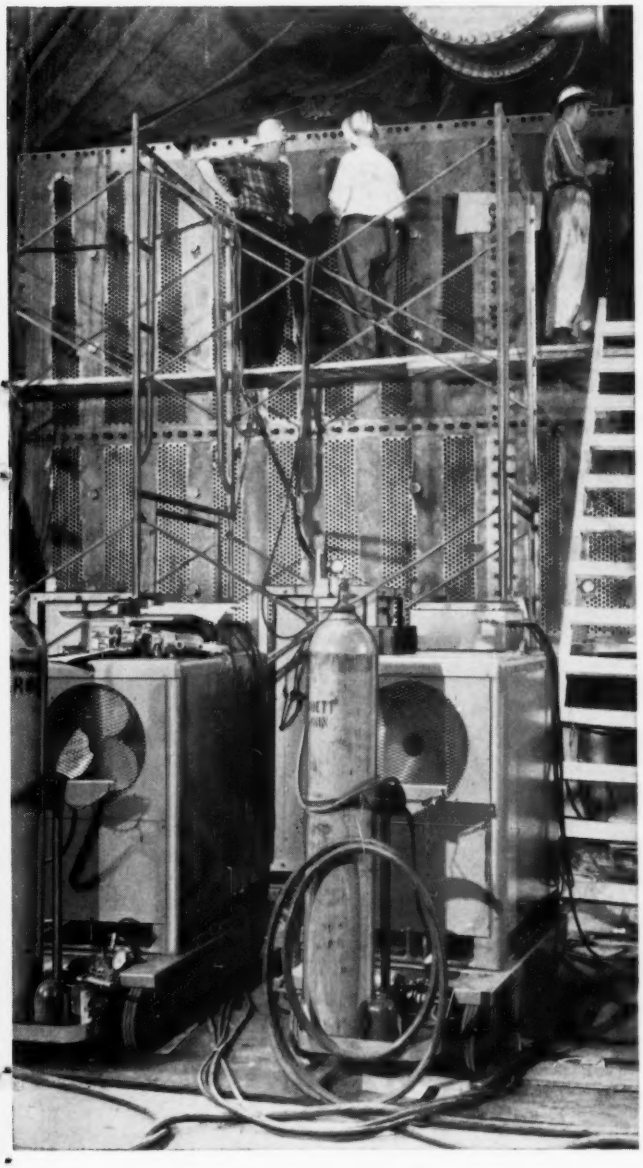
VISION • INGENUITY • DEPENDABILITY

MEAN ACCURACY FIRST

Now-
A-C
ALLIS-CHALMERS
A-5531

welded condenser tubes

Allis-Chalmers builds first condenser with welded tubes to insure against condensate contamination



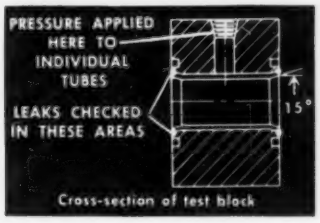
The big feature of this new 90,000-square-foot condenser: tubes are welded instead of rolled to form a seal with the tube sheets.

This type of construction is designed to meet the new problems created by supercritical pressures and nuclear power generation.

Several years of research by Allis-Chalmers preceded this installation at The Dayton Power and Light Co. It was necessary to determine the compatibility of various metals, develop welding techniques (including the special welding gun shown) and find ways of preventing distortion.

As a result of this research, conventional naval brass sheets and admiralty tubes can be used in this new unit. Circular grooves around each hole in the tube sheet help confine the heat to the area being welded, thus reducing welding current, tube sheet heating, and hence the possibility of distortion.

For further information regarding this new development, contact your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

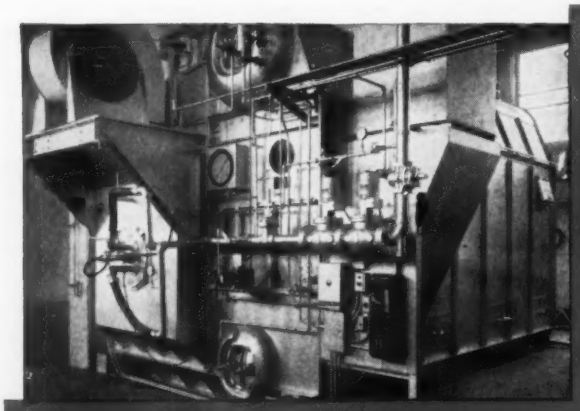


The 90,000-square-foot condenser for Unit No. 4 at Dayton Power and Light Company's Frank M. Tait Station. Although this is not a supercritical unit, the boiler is of the once-through design as used for supercritical installations.

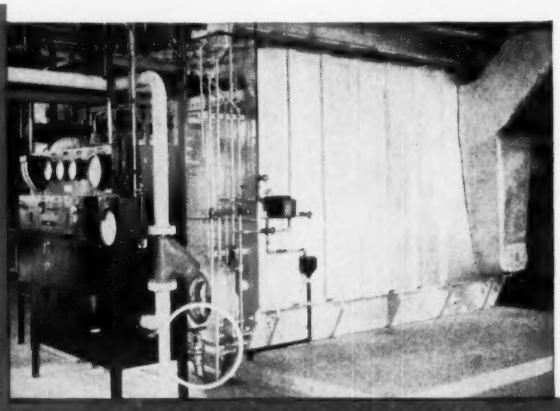
ALLIS-CHALMERS

the blow-off valve trend on "package" boilers is

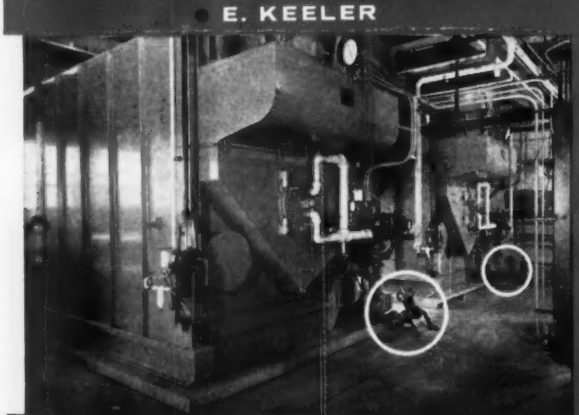
YARWAY SEATLESS



E. KEELER



COMBUSTION ENGINEERING



TITUSVILLE

KEWANEE-SPRINGFIELD

YARWAY® **BLOW-OFF**

■ More and more leading manufacturers of package-type boilers are featuring Yarway Blow-Off Valves on their units. Many are standardizing on Yarways.

The reason—good blow-off valves help good package boilers *perform better*.

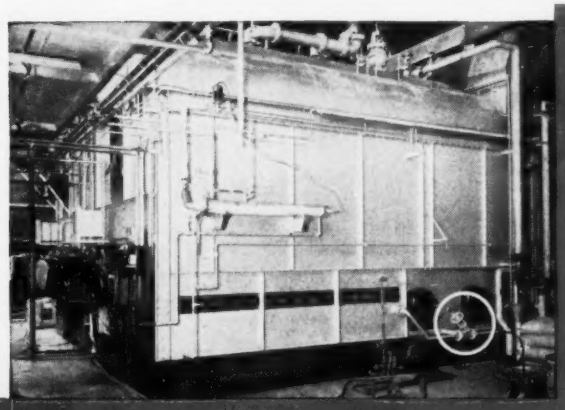
Yarway—known for nearly 50 years for *quality* blow-off valves—offers advanced design, dependable service, and reasonable cost . . . three features attractive to all boiler users.

The Yarway Seatless Blow-Off Valve, with balanced hollow sliding plunger and no seat to score, wear, clog or leak, is the most widely used valve for low and medium pressures.

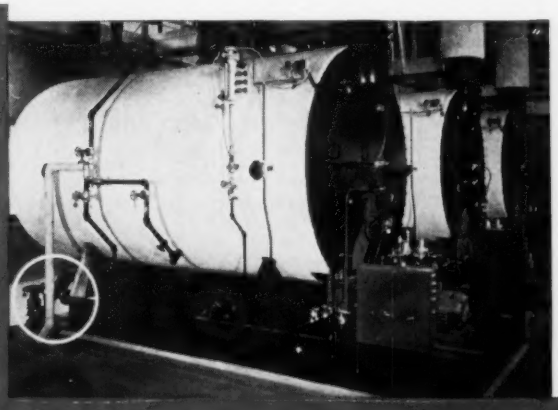
Specify Yarway Seatless Blow-Off Valves on your package boilers. All boiler makers will supply them.

For full description of Yarway Seatless Blow-Off Valves write for Yarway Bulletin B-426.

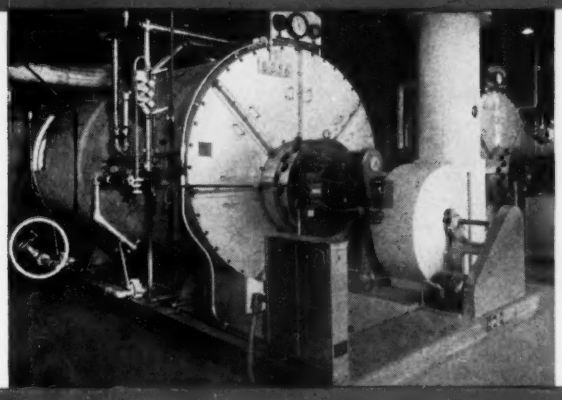
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



● ERIE CITY



● CLEAVER-BROOKS



● PREFERRED UTILITIES

● **Yarway Seatless Tandem Blow-Off Valve** (angle-straightway combination) with angle valve sectioned to show balanced sliding plunger design.

● **Yarway Seatless Tandem Blow-Off Valve,** angle-angle combination, straightway-angle or straightway-straightway tandems also available.

VALVES

For heat-saving protection that's permanent...

K&M "Featherweight" 85% Magnesia

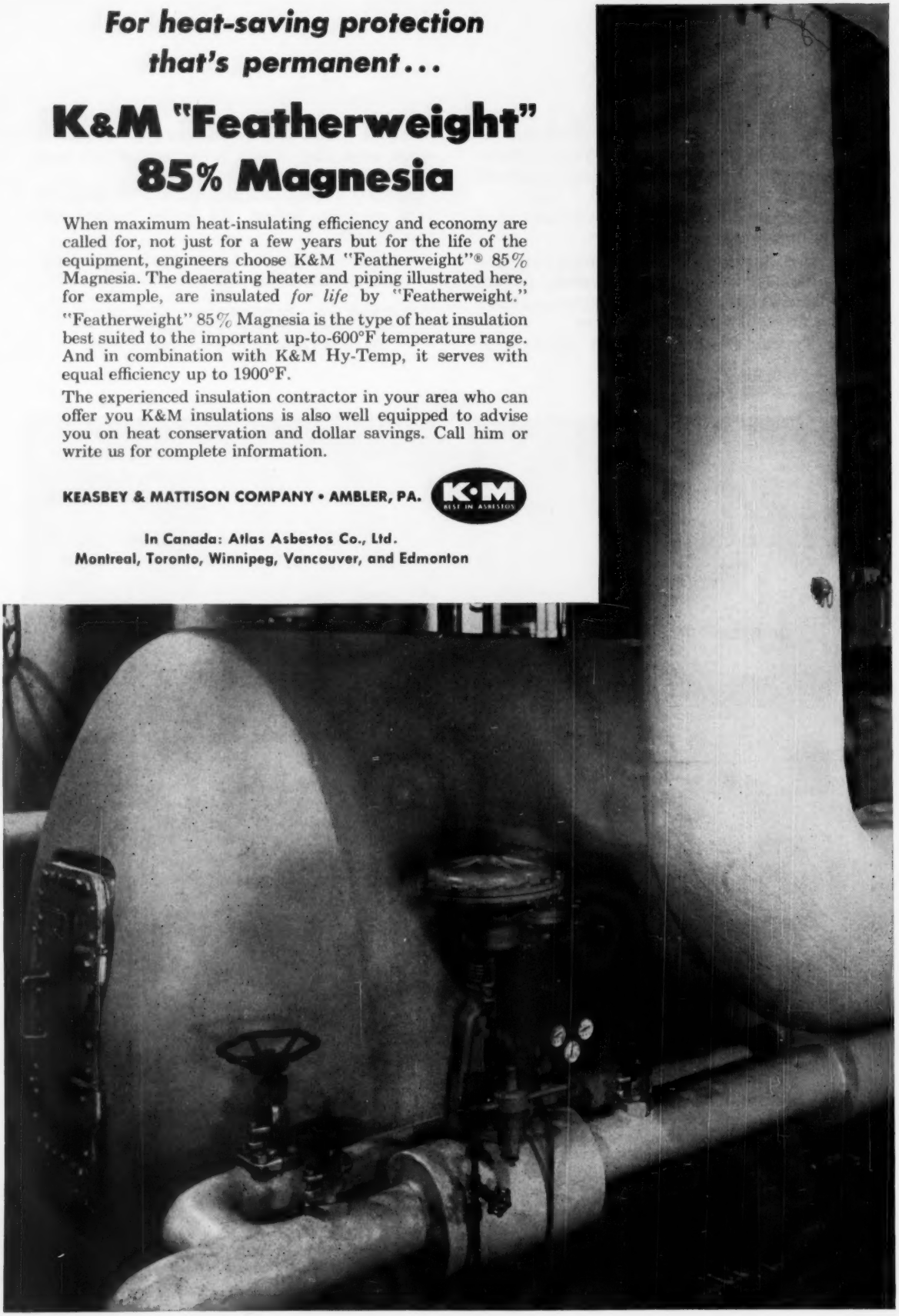
When maximum heat-insulating efficiency and economy are called for, not just for a few years but for the life of the equipment, engineers choose K&M "Featherweight"® 85% Magnesia. The deaerating heater and piping illustrated here, for example, are insulated *for life* by "Featherweight."

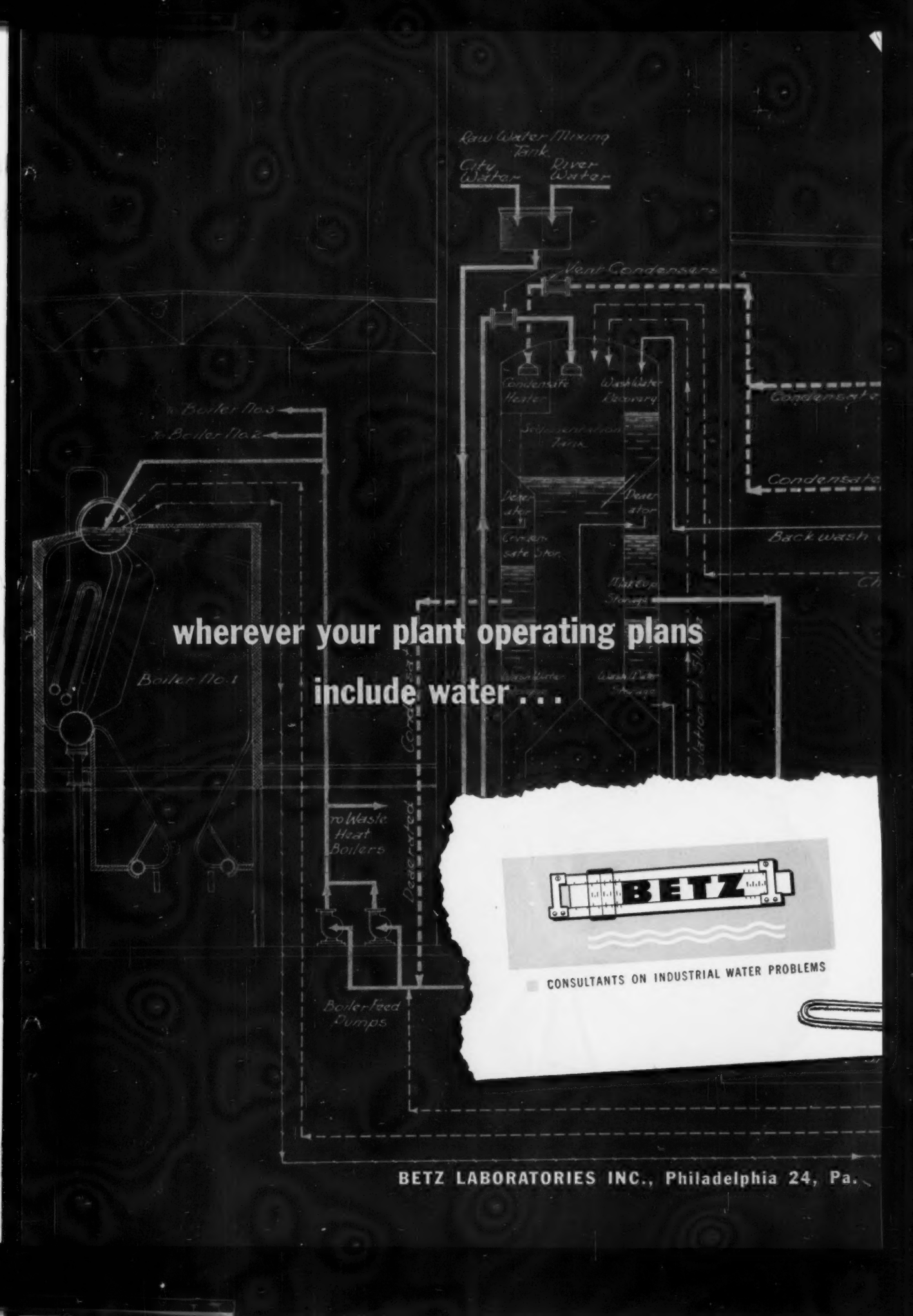
"Featherweight" 85% Magnesia is the type of heat insulation best suited to the important up-to-600°F temperature range. And in combination with K&M Hy-Temp, it serves with equal efficiency up to 1900°F.

The experienced insulation contractor in your area who can offer you K&M insulations is also well equipped to advise you on heat conservation and dollar savings. Call him or write us for complete information.

KEASBEY & MATTISON COMPANY • AMBLER, PA.

In Canada: Atlas Asbestos Co., Ltd.
Montreal, Toronto, Winnipeg, Vancouver, and Edmonton





wherever your plant operating plans include water . . .

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

BETZ LABORATORIES INC., Philadelphia 24, Pa.

Boiler-Burner Team Wins Seven Straight

Phillips Chemical Company orders Vogt boiler and Coppus-Dennis FANMIX burner combinations to make 1¾ million pounds of steam an hour

When a customer praises a product, that's fine. But when a customer *continually re-orders*, that's conclusive proof of user-satisfaction.

Phillips Chemical Company, Borger, Texas — producer of synthetic rubber — first installed Henry Vogt boilers with FANMIX burners back in 1943. As plant production increased, Phillips again purchased the same equipment — in 1946, and again in 1951.

Today, a total of 7 Vogt boilers equipped with Coppus-Dennis FANMIX burners provide 1,750,000 lbs. steam each hour for the production of synthetic rubber. The boilers are designed for 250,000 lbs. steam peak operation but have been operated as high as 275,000 lbs. per hour. Their performance is typical of the efficiency of boilers equipped with Coppus-Dennis FANMIX burners.

FANMIX · Better Combustion · Better Efficiency · Higher Ratings

All Coppus-Dennis FANMIX burners — for gas as well as combination gas-oil — have the exclusive FANMIX action. Their *revolving orifices* give violent mechanical mixing and agitation of gas and air, therefore causing instantaneous and complete combustion with *minimum excess air* (5% excess air is not unusual).

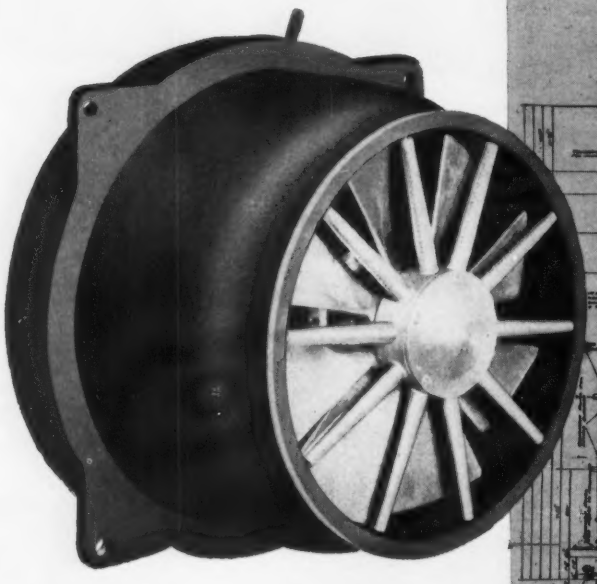
Because of this exclusive FANMIX action, furnace space is not required for mixing and *higher boiler ratings* are thus easily obtained. The burners also have a shorter flame than any other burner and will not cause flame impingement.

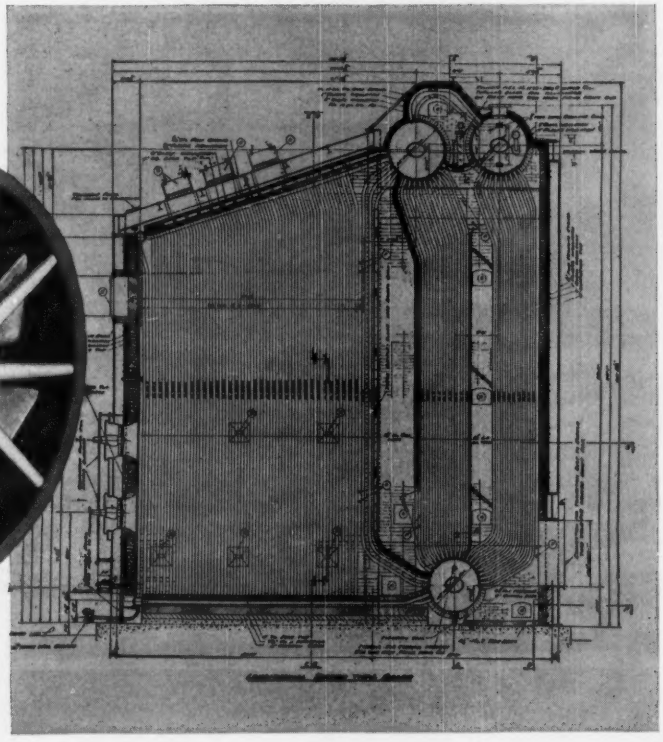
What's more, by incorporating a *fan* as an integral unit, FANMIX burners have *no draft loss* across the burner. As a result, increased ratings are possible regardless of draft conditions.

FANMIX action, with its quick completion of combustion, gives *lower* exit temperatures.

If you are not using Coppus-Dennis FANMIX burners in your present boiler, why not plan now to take advantage of the exclusive FANMIX action? You need no forced draft equipment, increase in stack or increase in furnace volume for FANMIX operation. And you get increased capacity. When specifying FANMIX on *new* boilers, you can plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity — and, of course, *no* forced draft equipment.

For further information, mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory* and *Mining Catalogs*.





JET REACTION is utilized to rotate fan which is integral part of burner. Ideal mixture for fast, complete combustion and peak efficiency is caused by automatically proportioned high velocity air passing at right angles through fuel.

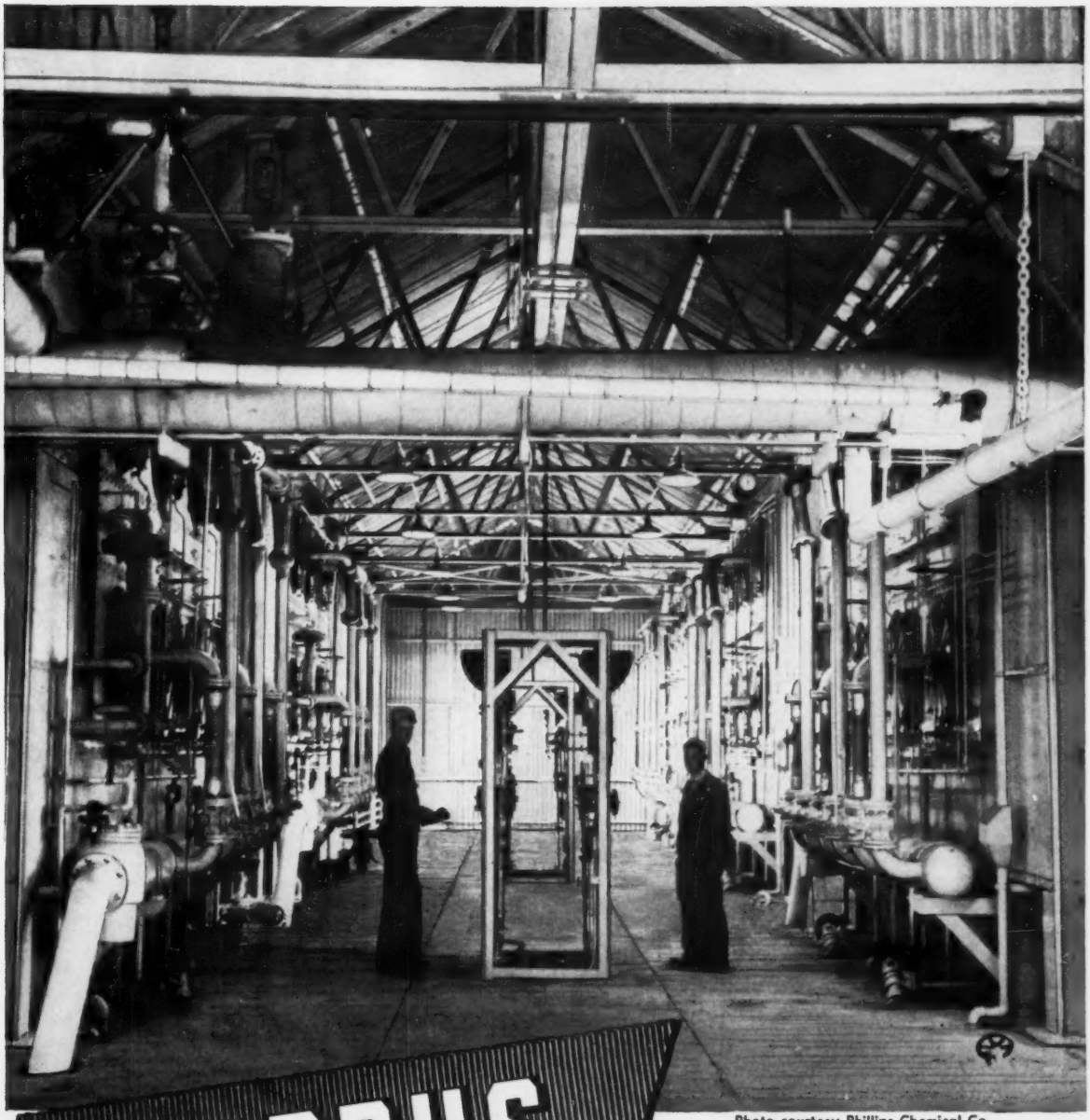


Photo courtesy Phillips Chemical Co.

HENRY VOGT BOILERS are here shown installed in the Phillips Chemical Company, Borger, Texas. Boilers use Coppus-Dennis FANMIX burners.

SEND COUPON for further information. Coppus engineers FANMIX burners to your individual requirements.

PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION
170 Park Avenue
Worcester 2, Massachusetts

Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in ☐ gas ☐ combination gas-oil.

Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

Pinehurst

tees off on fuel costs

Golfing resort cuts costs 33% with modern burning of coal

The central power plant at the famous golfing resort of Pinehurst, N. C., has to furnish a reliable supply of steam to three hotels and seven other buildings.

When Pinehurst recently decided to modernize power facilities, the consulting firm of Wiley and Wilson, Richmond, Va., was called in to study the situation. Since coal cost approximately 40% less than the nearest competitive fuel, the final decision called for burning coal the modern way. Today two new automatic stoker-fired boilers (only one of which is operated at a time) replace four 150-HP hand-fired boilers. Combustion control is automatic; coal and ash handling is greatly simplified. And now, according to management, "the cost of generating steam is 33.4% less than with the old plant."

Facts you should know about coal

Not only is bituminous coal the lowest-cost fuel in most industrial areas, but up-to-date coal burning equipment can give you 10% to 40% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at a stable price.

Technical advisory service

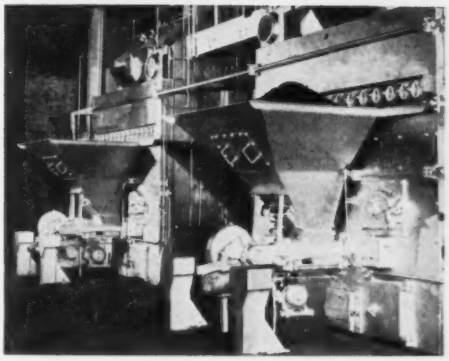
The Bituminous Coal Institute offers a free technical advisory service on industrial fuel problems. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

Consult an engineering firm

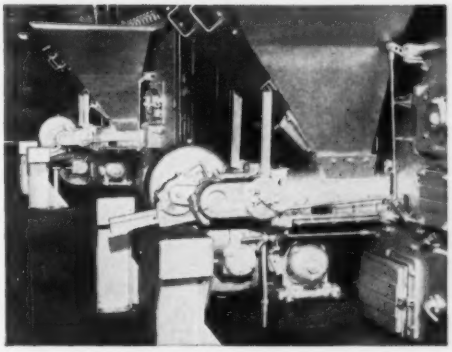
If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

BITUMINOUS COAL INSTITUTE

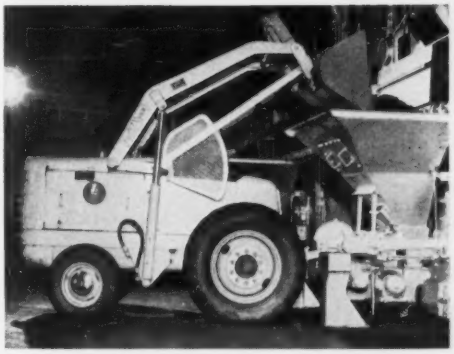
Southern Building • Washington 5, D.C.



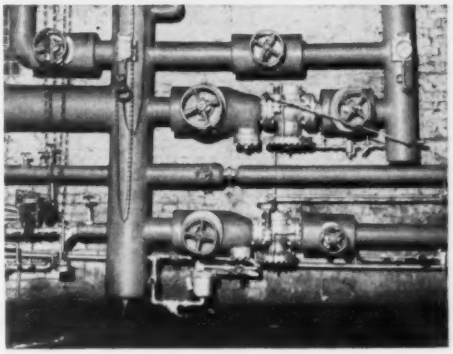
Two Babcock & Wilcox type FF integral-furnace boilers supply all the steam for Pinehurst at about 125 pounds pressure at 600° F. Average steam load is 11,000-12,000 pounds per hour per day.



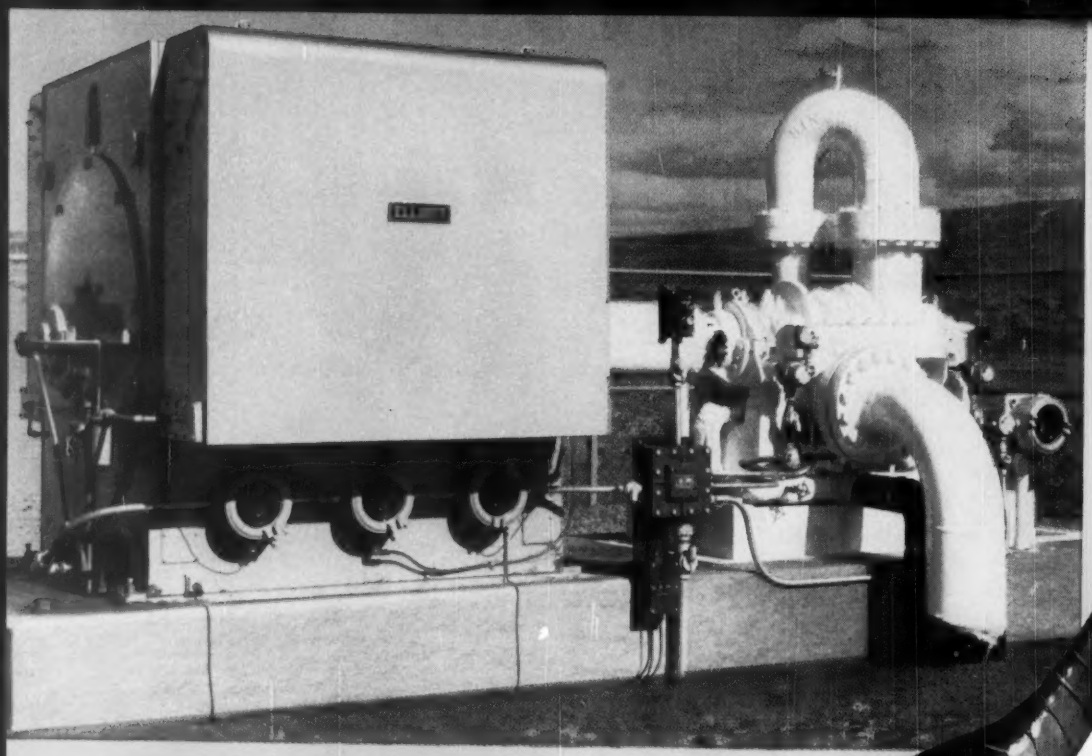
Close-up of stokers. These underfeed, single retort, side-dump models are made by Detroit Stoker. They operate automatically, each driven by a 3 HP enclosed motor.

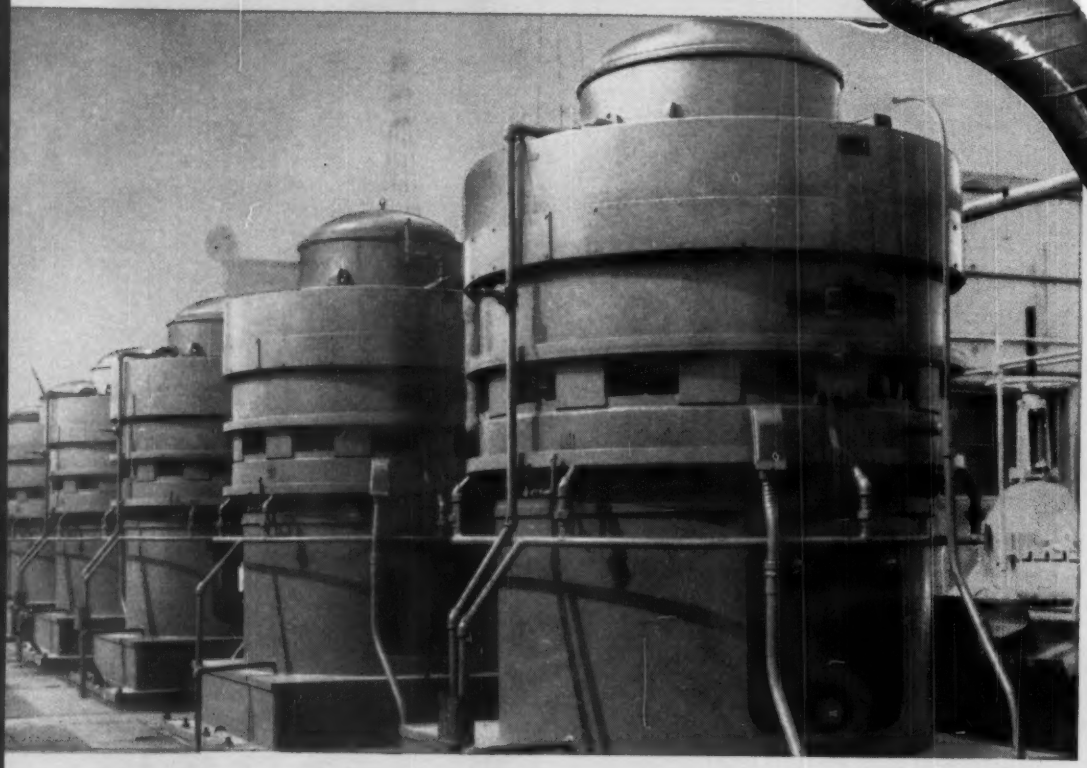


Frank G. Hough Payloader transfers coal from railroad trestle to storage, from storage to stokers. Payloader also facilitates handling of ash disposal.



Readily accessible, all of the steam distribution lines are taken off a manifold in the engine room. Five separate lines with Ruggles-Klingemann automatic pressure regulators distribute the steam at the required pressure in each case.





ELLIOTT Company

Ridgway Division, Ridgway, Penna.

in 1,900,000 HP of squirrel-cage induction motors . . .

not one insulation failure in 8 years with ELLIOTT

ELLIOTT Fabri-Seal INSULATION

Fabri-Seal insulation

The most astounding record of large motor dependability is this 8-year uninterrupted service of Elliott motors with Fabri-Seal insulation!

To achieve this, Elliott engineers devoted over ten years of intensive research and laboratory testing to create the Elliott Fabri-Seal insulation system for large induction motors. The finest insulating materials were meticulously selected and tested. Years of experimentation went into the development of improved methods of coil fabricating—such as exacting application by hand-wrapping critical areas and sealing the most vulnerable points. The objective was to achieve a coil insulating system—superior in every detail—to withstand severe temperatures, moisture and chemical fumes and assure long trouble-free life.

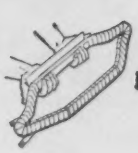
Since 1948, 1,900,000 hp of large squirrel-cage induction motors with Fabri-Seal coil insulation have been put into actual field service. The result was unprecedented. In eight years, *not one Elliott large induction motor stator coil has failed due to insulation breakdown.*

What's more, 700,000 hp of these were Elliott weather-protected motors (similar to installations seen here). And, although these machines are operating in rigorous outdoor applications in extremes of humidity, rain, snow, sleet, hurricanes, desert heat, oil fumes and salt spray—*not one of them in 8 years*—has failed due to faulty insulation.

RT-26

Elliott's outstanding Fabri-Seal insulation "field-proven" for over 8 years . . . shatters all previous service records!

IMMERSION "TORTURE-TEST"
quickly locates potential trouble-spots. It has been vitally important in the perfection of Elliott Fabri-Seal insulation.

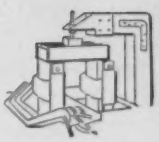


MYLAR*-BACKED MICA WRAPPER
—hand-wrapped around all stator coil slot sections—proven ability to withstand severe temperature and age.

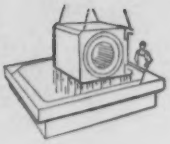
*Dupont trademark

SEALED AT VULNERABLE POINTS
Prevents entrance of moisture or contaminants which commonly cause failure in conventional insulating systems.

VACUUM AND PRESSURE IMPREGNATION
Air and moisture are removed, then moisture- and acid-resistant insulating varnish penetrates coils.



TURN-TO-TURN TESTED
Subjects each turn to high surge voltage many times greater than normally imposed in actual field service.



EVERY STATOR COMPLETELY IMMERSED
in special, flexible varnish, then baked. Coil end-turns, leads and joints given two more dips and bakes.

Avoid costly downtime from dirty process water

Clarify it with Celite filtration

PROCESS WATER which contains colloidal color and suspended solids may cause costly downtime or damage expensive plant equipment.

Celite* filtration prevents fouling of resin beds in softeners and demineralizers. It also assures clean, clear water for boiler feed, cooling towers, heat exchangers, scrubbing towers and other process operations where slime, sludge or mud deposits can cause serious trouble.

Celite removes more suspended solids than other types of clarification—even amoebae and algae and most bacteria if required. It operates at fast flow rates with any conventional pressure filter. It comes in 9 standard grades for precise clarity control. And it is low in cost.

A Celite engineer will be glad to study your water problem and offer his no-obligation recommendations. Write Johns-Manville, Box 14, N. Y. 16, N. Y. In Canada, Port Credit, Ont.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

JOHNS-MANVILLE JM PRODUCTS

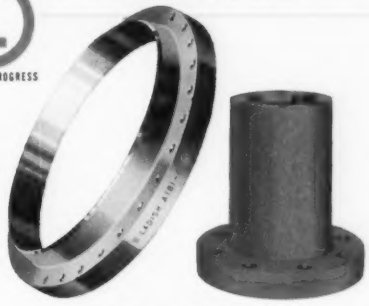
Johns-Manville CELITE diatomite filter aids

IPS—BUTT WELDING FITTINGS
½"-42" From Sch. 5S to 4" Walls

ASA and MSS FLANGES
½"-24" 150 through 2500 lbs.

TO MARK PROGRESS

TUBE O.D.—BUTT WELDING FITTINGS
½"-36" From .049" to .250" Wall



LARGE O.D. and TEMA FLANGES
Up to 20' in Diameter
LONG WELDING NECKS
1"-24" 150 through 2500 lbs.

UNIONS
⅛"-4" 150 lbs. and 2000 through 6000 lbs.

SCREWED and SOCKET FITTINGS
⅛"-4" 150 lbs. and 2000 through 6000 lbs.

LADISH

FOR *Complete Service* IN *Controlled Quality*

FORGED AND WROUGHT FITTINGS

CARBON • ALLOY
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AND ALUMINUM

WHATEVER your fittings requirements . . . regardless of the type, size, wall thickness, pressure rating or material specification . . . you can get prompt, efficient, *complete service* by specifying LADISH and ordering from your local Authorized Ladish Distributor.

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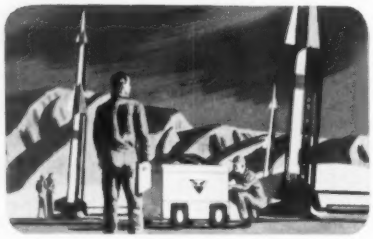
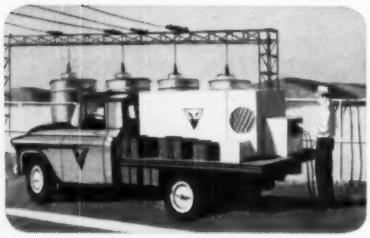
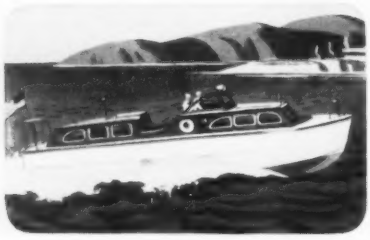


Missile Applications

Ground Support for Jet Aircraft

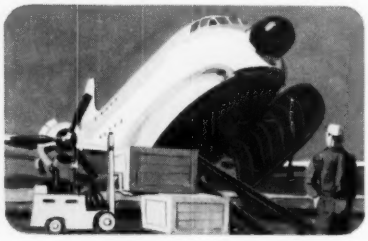


Portable Power Generation

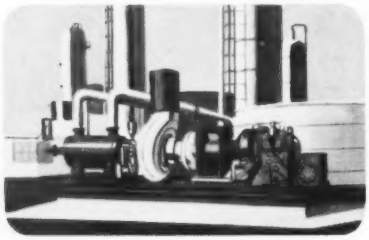


Small Boat Propulsion

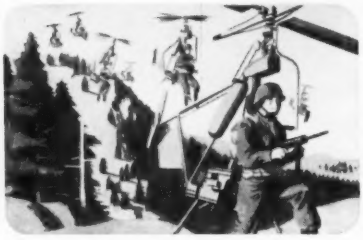
Portable Fire Pumps



Auxiliary Power for Aircraft



Turbine Drives for Process Pumps



Power for One-Man Helicopters

Emergency Stand-by Power

Here are nine Solar gas turbine uses! Can you think of more?

SMALL-SIZE SOLAR GAS TURBINES offer a radical new power concept for forward-looking businesses. Their easy portability, high power-to-weight ratio and reliability make them ideally suited for applications beyond the scope of conventional engines. They are easy to maintain, start instantly after long periods of inactivity and can burn a wide variety of fuels—including gasoline, kerosene, diesel oil and others.

Shown above are only nine of the many uses for these new prime movers—and additional applications are limited only by the imagination. To date more than 1000 Solar gas turbines have been sold. They are serving 35 different customers in more than 50 applications. Current production models—the 50 hp Mars® and 500 hp Jupiter®—are being turned out in volume for a growing list of satisfied military and commercial users. And development work on a new 1000 hp Saturn engine is going forward.

For more than a decade Solar has been making important contributions in the gas turbine field. Whatever your business, whatever your special power needs, perhaps a versatile Solar gas turbine can provide the answer. For a new gas turbine brochure, write to Dept. D-89, Solar Aircraft Company, San Diego 12, California. *Designers, developers and manufacturers of gas turbines, expansion joints and aircraft engine, airframe and missile components.*

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

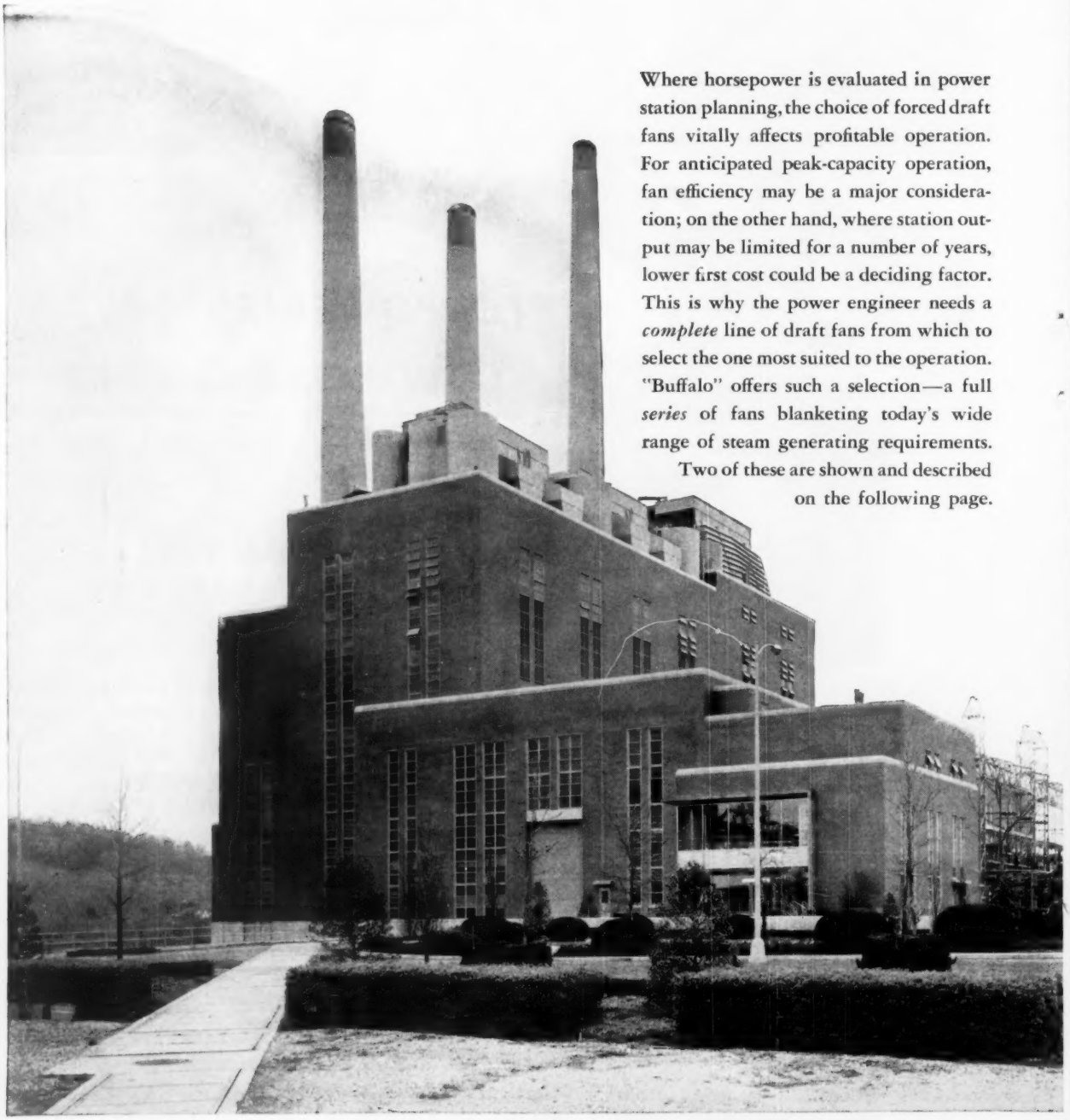
ENGINEERS WANTED. Unlimited opportunities, challenging projects, good living with Solar! Write for brochure.

• Bituminous coal contributes to plant operating profits by its *productivity* and *stability*. Virtually limitless supply, plus most modern mining methods, gears production to *any volume demand.*

Accessibility and increasingly efficient burning equipment mean economical, constant-cost for today and tomorrow.

Ask our man! **BALTIMORE & OHIO RAILROAD, BALTIMORE 1, MD., Phone: LExington 9-0400**

WHERE HORSEPOWER IS EVALUATED



Where horsepower is evaluated in power station planning, the choice of forced draft fans vitally affects profitable operation. For anticipated peak-capacity operation, fan efficiency may be a major consideration; on the other hand, where station output may be limited for a number of years, lower first cost could be a deciding factor. This is why the power engineer needs a *complete* line of draft fans from which to select the one most suited to the operation. "Buffalo" offers such a selection—a full *series* of fans blanketing today's wide range of steam generating requirements.

Two of these are shown and described on the following page.

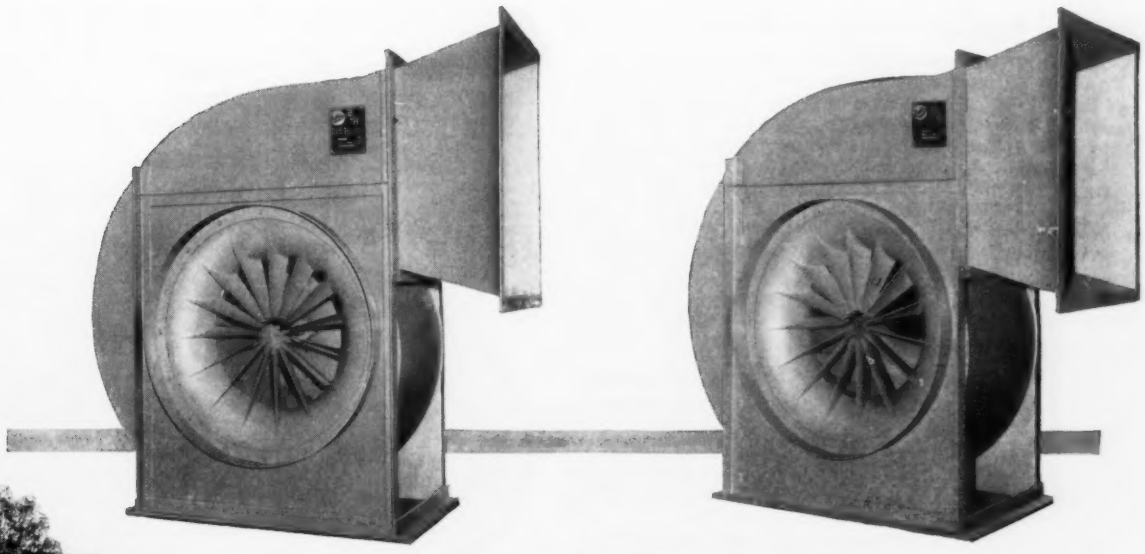
—THESE "BUFFALO" DRAFT FANS
OFFER IMPORTANT ADVANTAGES

High Efficiency Over a Broad Range—Type "BLH" F. D. Fan

This backward-curve fan is providing performance characteristics highly desirable for many stations. Designed for Classes II-IV operation (system pressures above 3¾"), its mechanical efficiency is above 80% over a very broad range, providing flexibility over wide load variations. Its complete streamlining includes the proven inlet bell, directional inlet vanes, backward curve blades, wheel-suited housing and divergent outlet — features offered exclusively by "Buffalo". Like the "Buffalo" Airfoil Fans, the "BLH" is used efficiently with "Buffalo" Variable Inlet Vane volume control. Write for Bulletin F-200.

Maximum Efficiency for Specific Operating Conditions— Type "BA" Airfoil F. D. Fan

"Buffalo" Airfoil Fans offer mechanical efficiency up to 92%, and are available with a choice of three wheels to match widely varying pressure requirements. These fans have extra-wide blades for a deep "bite" — extremely good inlet conditions, thanks to the smooth inlet bell and matching curved wheel flange — plus excellent static conversion thru the unique new "Buffalo" divergent outlet. Available with "Buffalo" Variable Inlet vanes — which do not reduce performance — for volume control. Write for Bulletin FD-106 for full details.



In every "Buffalo" product is the "Q" Factor, or built-in Quality which provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY
BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Kaiser Aluminum sheet for jacketing offers new economies through improved application methods

Recent developments make possible new low costs for the power, refinery and chemical industries

As you can see in the relative cost charts at the right, aluminum sheet jacketing now offers the *lowest first cost* of four well-known finishing methods for pipe insulation . . . and it offers *lower first cost* than wet-construction finishing methods for vessel insulation.

Another important fact, not revealed in the charts, is that aluminum's first cost is becoming *increasingly* competitive, thanks to newly-developed methods that speed application and reduce labor costs!

And if maintenance costs were added to the comparisons, aluminum would present an *even better value*—because only aluminum eliminates maintenance.* Its remarkable resistance to corrosion eliminates the need for painting . . . even when exposed to weather and mechanical abuse.

New Dry Wall Construction for Vessels

A number of improvements in application technique—developed by Kaiser Aluminum engineers in cooperation with specialists from various industries—adapt dry-wall type construction to the finishing of large cylindrical and flat insulated surfaces. These techniques virtually eliminate the need for costly application methods used to apply wet materials such as insulating cements, emulsions, mastics, adhesives, glue sizing and paint. Where corrugated aluminum sheets are used, positioning and fastening are simplified and speeded by familiar techniques employed for block insulations.

New "Snap-Back" Aluminum Jacketing Speeds Installation on Piping

Aluminum's unique advantages in light weight and superior workability have made possible greatly simplified preformed "snap" jackets for quick, easy application on piping.

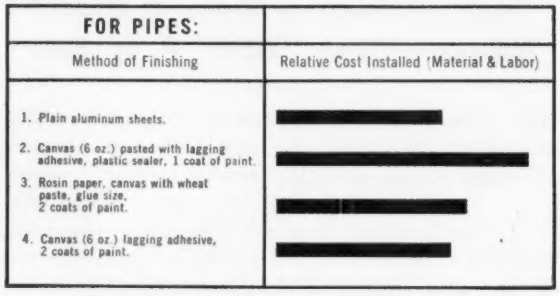
Jacketing, preformed into undersize tubes from stiff sheets of aluminum, will snap back to a tight fit when placed over pipe insulation, freeing both hands for fastening. This tight fit requires less fasteners per running foot.

The following is an outline discussion of important factors in aluminum jacketing materials and alloys, with suggested application methods best suited to various insulated surfaces, including pipes, vessels, vessel heads and others.

The Jacketing Alloys

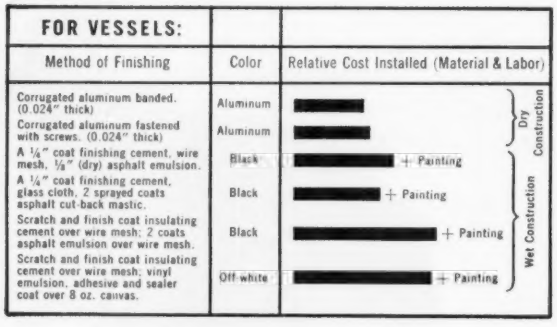
The following aluminum alloys, supplied in flat or coiled sheets, are successfully used for insulation jacketing: 1100, 3003, 3004, 5005, 5050, 5052, Kaiser Aluminum industrial roofing and siding alloy, and Kaiser Aluminum standard roofing alloy.

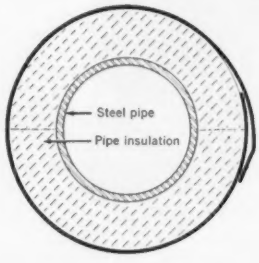
*Roofing felt has a lower initial cost than aluminum, but painting and maintenance offset this initial cost advantage.


FOR PIPES:
Method of Finishing
Relative Cost Installed (Material & Labor)
1. Plain aluminum sheets.
2. Canvas (6 oz.) pasted with lagging adhesive, plastic sealer, 1 coat of paint.
3. Rosin paper, canvas with wheat paste, glue size, 2 coats of paint.
4. Canvas (6 oz.) lagging adhesive, 2 coats of paint.

Results of first cost analyses of various insulation finishes

NOTE: Charts show first costs only. To arrive at total costs, maintenance costs must be added. Whereas other finishing methods require frequent and costly maintenance, aluminum jacketing is virtually maintenance-free.


FOR VESSELS:
Method of Finishing
Color
Relative Cost Installed (Material & Labor)
Corrugated aluminum banded. (0.024" thick)
Aluminum
Corrugated aluminum fastened with screws. (0.024" thick)
Aluminum
Dry Construction
A ¼" coat finishing cement, wire mesh, ⅛" (dry) asphalt emulsion.
Black
+ Painting
A ¼" coat finishing cement, glass cloth, 2 sprayed coats asphalt cut-back mastic.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh; 2 coats asphalt emulsion over wire mesh.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh; vinyl emulsion, adhesive and sealer coat over 8 oz. canvas.
Off-white
+ Painting
Wet Construction



Sketch shows how preformed jacketing snaps back over piping, providing quick installation combined with tight fit. This is also demonstrated in photo titled "Teamwork."

Based on maximum economy and performance, the general recommendation is the use of Kaiser Aluminum alloy 5005 and Kaiser Aluminum industrial roofing and siding.

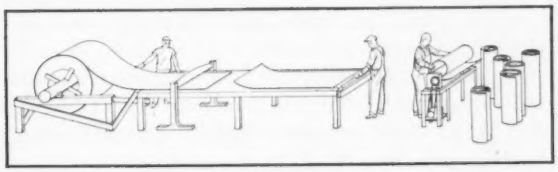
The reasons for this recommendation, and the exceptions to it, are as follows:

(a) Alloys in the 5000 series (which contain magnesium as the principal alloying element) and the clad alloys, such as AlClad 3004 (from which Kaiser Aluminum industrial roofing and siding sheet is made), offer superior corrosion resistance—especially in marine atmospheres.

(b) Alloy 5005 and the industrial roofing and siding alloy provide top performance at lowest cost for most jobs. Alloy 5050 shows an advantage from the standpoint of strength over 5005, and in many instances its slightly increased cost (a fraction of a cent per square foot) is warranted. Where exceptional strength is required, alloy 5052 should be used.

(c) Closely allied with alloy selection is a consideration of the section modulus of jacketing for large diameter vertical vessels. Kaiser Aluminum industrial roofing and siding sheet is superior in section modulus. On certain vertical vessels, usually those in the range of 3′ to 12′ in diameter, some designers prefer the close-up appearance of smaller corrugations. When this is preferred, most of the common alloys and the standard corrugated roofing alloy are satisfactory. Sheets should be 0.024″ thick, embossed, corrugated to 1¼″ x ¼″, and supplied in finished widths of 26″.

A metal thickness of 0.024″ is recommended in most cases. Corrugated aluminum 0.024″ thick can be banded at less material and labor cost than the thinner 0.019″ material fastened with screws. For insulated pipes with an O.D. of 12.75″ and less, 0.020″ thick aluminum sheet is recommended.



These illustrations show method used to fabricate snap jackets:

1. Using aluminum of proper alloy and temper . . .
2. Cutting it to proper dimensions for easy, economical installation . . .
3. Properly stiffening the overlapping edge by a simple angular crimp . . .
4. Forming it through a roller for proper circumference . . .
5. Snapping it around insulated pipe (below).

Teamwork—with one man to snap jackets in place and another to band them, two men can cover 700 feet of 10-inch diameter tubing in one day!

The best temper for pipe jacketing is ¾ hard, designed as H-16 or H-36. For fitting jackets requiring numerous lock seams, ½ hard temper, H-14 or H-34, is recommended.

Pipe Jackets

Snap jackets are a quick, easy and economical method of enclosing insulated pipe. The simple process shown above produces a most effective jacket for pipe insulation. (Kaiser Aluminum's booklet, *"Insulation Jacketing Materials and Methods,"* explains and describes the process in full detail.)

The alloy recommended is 5005-H16, in coiled sheet form with plain finish. Embossed finishes are also available. Other alloys may be used, but it is desirable to use one alloy throughout. Width of coiled sheet should be 36″. Recommended thicknesses of sheets are 0.020″ for insulation O.D. of 12.75″ and under, and 0.024″ for insulation O.D. of 14″ and larger.

Vessel Jackets

Insulated vessels 36″ O.D. and less—horizontal or vertical—should be jacketed with 0.024″ thick by 36″ wide 5005-H16 alloy sheet, plain finish preferred.

For insulated vessels larger than 36″ O.D., horizontal mounting, use the same coiled sheet as above; for vertical mounting, use Kaiser Aluminum industrial roofing and siding, 0.024″ thick, embossed finished, ⅞″ deep corrugations with 2.67″ pitch.

Jackets for Large, Flat Surfaces

For breechings and ducts, indoors and out, Kaiser Aluminum industrial roofing and siding, 0.024″ and 0.032″ thick and having ⅞″ deep by 2.67″ pitch corrugations are most economical. Flat sheet, fluted sheet, and flat sheets stiffened with roll-formed standing seams offer other possibilities.

For insulated boiler walls, jackets may be made of aluminum sheets of several types. Thickness, size and fastening method will vary with specific boiler designs.

Fasteners

For pipes and vessels with insulation O.D. 36″ or smaller, bands may be slit from the same aluminum sheet used for pipe jackets, or they may be purchased as standard stock items. For pipe insulation O.D. 12.75″ and smaller, bands should be ½″ wide by 0.020″ thick, equal to A. J. Gerrard #305-AL; seals should be equal to A. J. Gerrard #202-AL. For pipe or vessels with insulation O.D. 14″ to 36″, bands should be ¾″ wide by 0.020″ thick, equal to A. J. Gerrard #311-AL; seals should be equal to A. J. Gerrard #204-AL. For vessels with insulation O.D. 36″ and larger, ¾″ wide by 0.020″ thick #18-8 stainless steel expansion bands should be used. Banding should be equal to A. J. Gerrard Expand-R-Strap, #E311 ½ S-4; seals should be #18-8 stainless steel, equal to A. J. Gerrard #204-SS.

When required for pipe and fitting jackets, #7 by ½″ aluminum pan head self-tapping screws, Type A, are suggested. Side laps and flashing with corrugated vessel jackets should be fastened with #7 x ¾″ aluminum pan head screws, Type A. Aluminum screws should be made from either 6061-T6 alloy or anodized 2024. For fastening aluminum jackets to steel structural members, use #14 hex head screws, Type B, made from stainless steel #18-8 alloy; #410 is acceptable.

Composite studs made from #18-8 stainless steel and aluminum (equal to Nelson Rivweld Studs or to Nelson Set Lock Studs supplied with aluminum washers) may be used to fasten corrugated aluminum jackets to angles. On siding, fasten studs on low part of corrugation. On roofing, fasten studs on crown of corrugation.

Aluminum Jacketing Booklet Available

Kaiser Aluminum's new booklet, *"Insulation Jacketing Materials and Methods,"* gives you complete details on the subjects outlined above. It also presents illustrated step by step application methods plus material and accessories charts to help you take advantage of recent advances in aluminum sheet jacketing. Forty fully illustrated pages in all! To get your free copy, write to: *Kaiser Aluminum & Chemical Sales, Inc., Process Industries Department, 919 N. Michigan Ave., Chicago 11, Illinois.*

KAISER Aluminum

Uniformity of Republic ELECTRUNITE® Boiler Tubes

INCREASES ERECTION AND OPERATING EFFICIENCY

of Modern Steam Generating Equipment

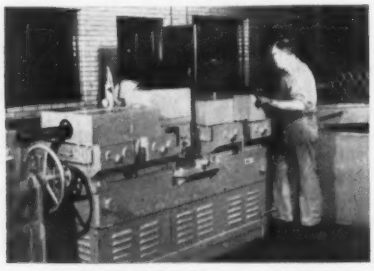
More power per dollar demands top efficiency in steam-generating-equipment design, erection, and operation. Materials used must meet these requirements and deliver long, trouble-free service as well. Republic ELECTRUNITE Boiler Tubes fulfill all conditions with flying colors.

The Riley "RX" Steam Generating Unit with Pressurized Furnace, at right, provides an excellent example. Designed and erected by the Riley Stoker Corporation, Worcester, Massachusetts, for the Phillips Petroleum Company Refinery at Sweeny, Texas, this unit develops 325,000 pounds of steam per hour at 500 psi. and 610° F. A total of 49,785 feet of Republic ELECTRUNITE Boiler Tube was used. Its uniformity made a significant contribution to construction economy, and assures long-term operating dependability.

Uniform quality throughout each tube is based on Republic's complete manufacturing control. The ELECTRUNITE welding process produces accurate size, concentricity, and wall thickness. Material-control, from ore to finished tubing, builds uniform strength and ductility into every length. Result is a fully predictable boiler tube that facilitates time-saving prefabrication techniques, easy "rolling-in" characteristics, and fast field assembly—and provides maximum service life.

Republic ELECTRUNITE Boiler Tubes are hydrostatically or electronically tested to meet applicable ASTM specifications, the ASME Boiler and Pressure Vessel Code, and local, state, and boiler-insurance requirements. It is approved on an equal basis with tubes made by any other process, up to 850° F, and available for pressures over 2000 psi. in a variety of sizes and wall thicknesses.

For complete information on ELECTRUNITE Boiler, Condenser, and Heat Exchanger Tubes, contact your local Republic representative. For illustrated literature, mail coupon.



SPECIFY FARROWTEST®—the most conclusive, non-destructive tubing test in use today. Developed by Republic, FARROWTEST uses electronic detector coils to spot hidden irregularities in tube walls that would escape routine test procedures.

UNIFORM DUCTILITY AND CONCENTRICITY plus precise diameter assures easy installation of Republic ELECTRUNITE Boiler Tubes in drums. They slide in readily, roller-expand evenly, and bead over to form tight, weeper-free joints.

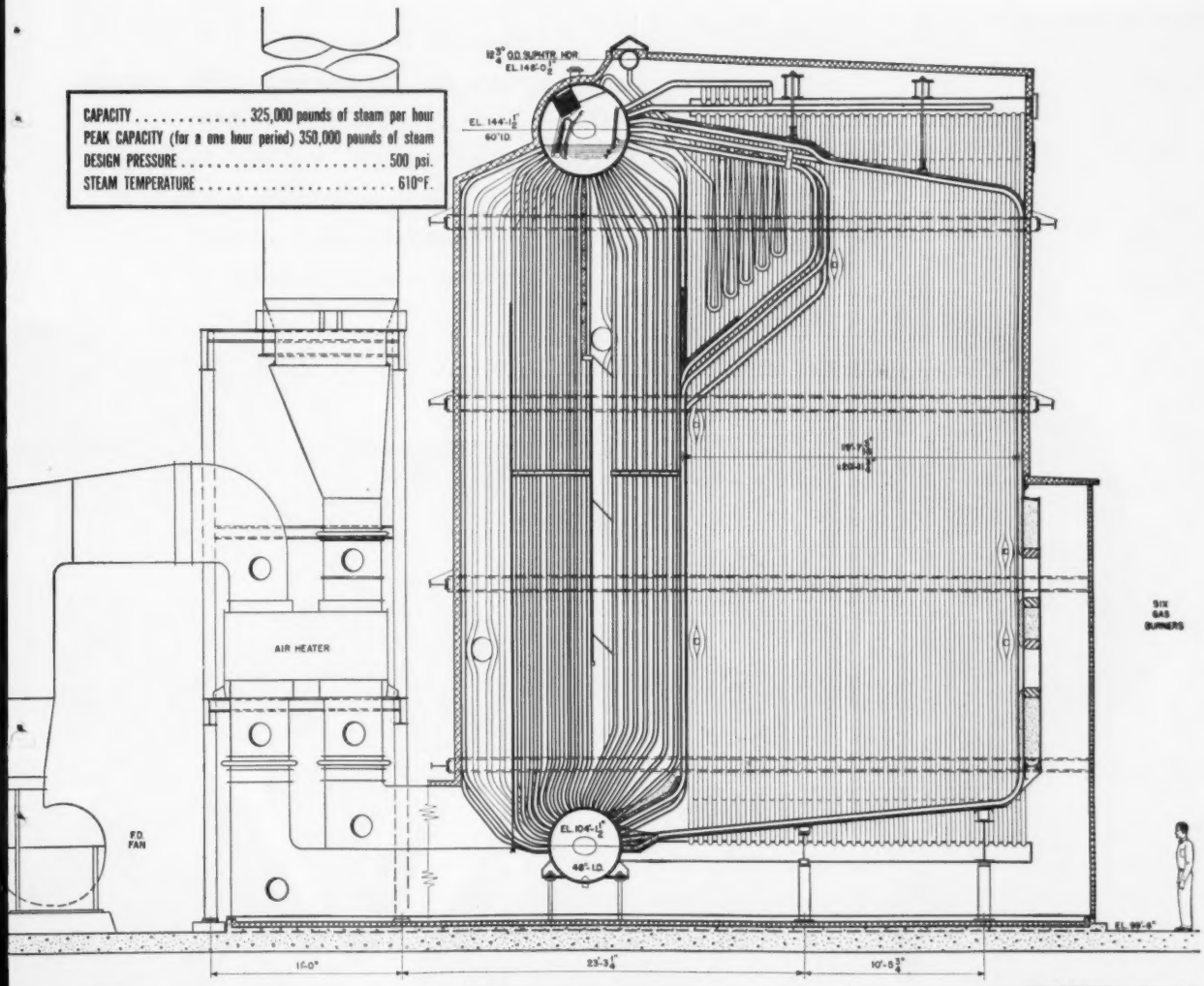
PREFABRICATION OF BOILER TUBE ASSEMBLIES was employed by Riley to speed erection of steam generator shown in diagram. Predictable characteristics of ELECTRUNITE simplified this operation, assuring easy bending to precise contours.

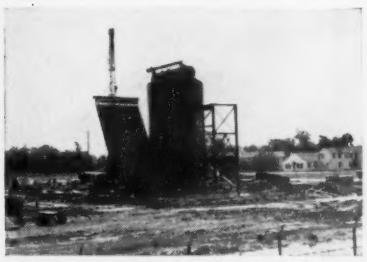
REPUBLIC

REPUBLIC STEEL

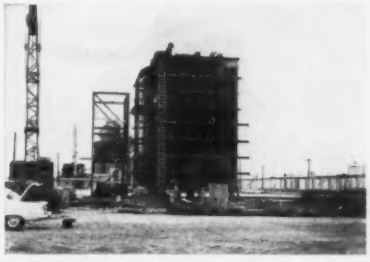
World's Widest Range of Standard Steels

CAPACITY . . . . . 325,000 pounds of steam per hour
PEAK CAPACITY (for a one hour period) 350,000 pounds of steam
DESIGN PRESSURE . . . . . 500 psi.
STEAM TEMPERATURE . . . . . 610°F.

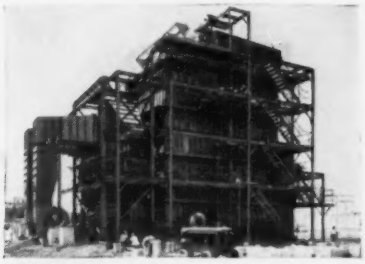




HEADER WITH PRE-ASSEMBLED TUBING is quickly and efficiently raised into position by crane used for building construction. Beyond savings in time, this technique makes top quality of completed unit easier to achieve.



FINAL STAGES OF ERECTION include a careful inspection. Republic ELECTRUNITE Boiler Tubes provide maximum reliability throughout every length. There are no hidden thin spots to threaten service life or cause uneven heat transfer.



JACKET INSTALLED, Riley Steam Generator is virtually complete. Republic offers a handy guide outlining proper protection of boiler installations. Send coupon for wall chart entitled "Care and Maintenance of Boiler Tubing", today.

STEEL

and Steel Products

REPUBLIC STEEL CORPORATION
DEPT. C-3954R
3144 EAST 45th STREET, CLEVELAND 27, OHIO

Please send:

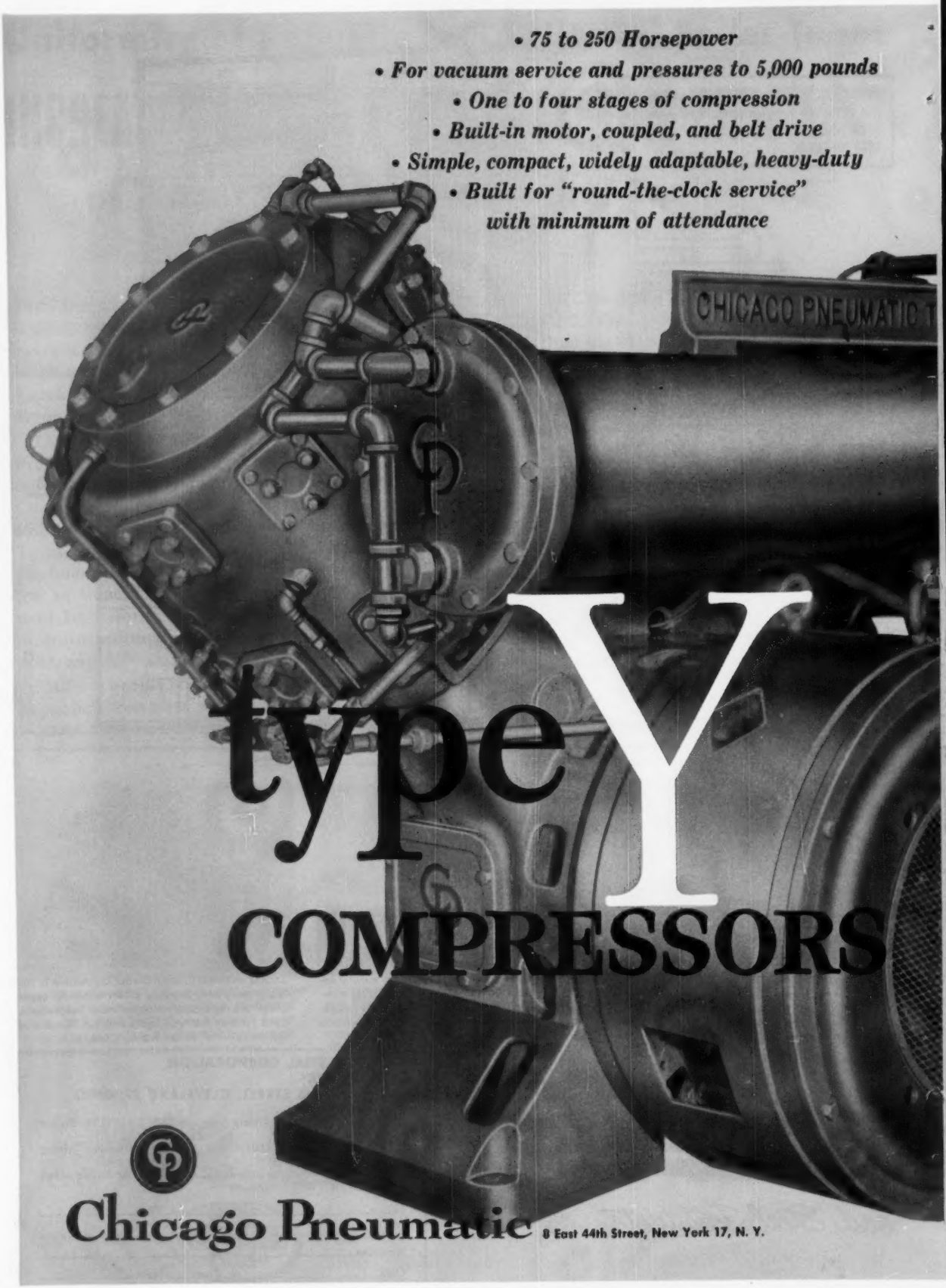
- ☐ Illustrated booklet giving facts on ELECTRUNITE Boiler Tubes
- ☐ 8-page brochure on ELECTRUNITE Heat Exchanger Tubing ☐ carbon steel ☐ stainless steel
- ☐ Handy wall chart on care and maintenance of boiler tubes
- ☐ FARROWTEST brochure

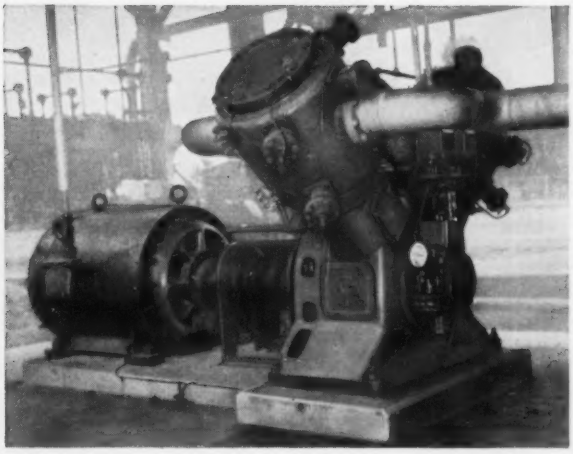
Name_____ Title_____

Company_____

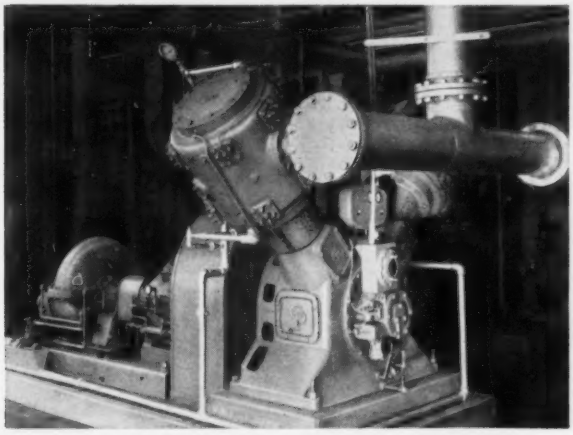
Address_____

City_____ Zone____ State_____


• 75 to 250 Horsepower
• For vacuum service and pressures to 5,000 pounds
• One to four stages of compression
• Built-in motor, coupled, and belt drive
• Simple, compact, widely adaptable, heavy-duty
• Built for "round-the-clock service"
with minimum of attendance
CHICAGO PNEUMATIC
type Y
COMPRESSORS
Chicago Pneumatic
8 East 44th Street, New York 17, N. Y.



Butane compressor, direct coupled to an explosion-proof motor, in a prominent refinery.



Non-lubricated, single-stage compressor driven by steam turbine through a reduction gear.

Four-stage high pressure unit available with flange-mounted, belted, or coupled drive.

ONE-MAN SERVICE . . . without

removing contactor or arc boxes

AMPGARD*

Westinghouse

high-voltage starters with

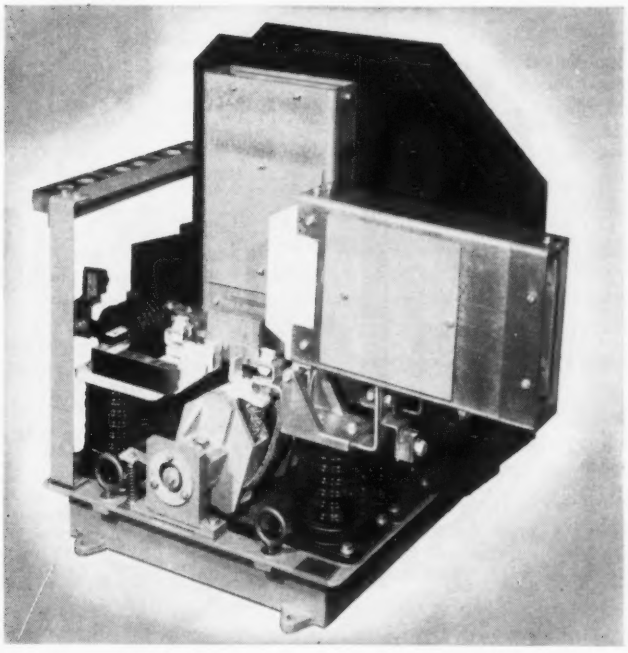
Type H air-break contactors

AMPGARD is delivered *completely* factory wired and assembled . . . just make the line and load connections . . . and you're in business. No need to wire up and assemble separate contactor units. The stationary Westinghouse contactors are easily accessible for inspection or service. Arc boxes of the Westinghouse AMPGARD starter can be quickly and easily tilted forward with one hand . . . leaving the contacts exposed and easy to reach. No need to disassemble and remove heavy, awkward arc boxes to make regular checks or perform routine service.

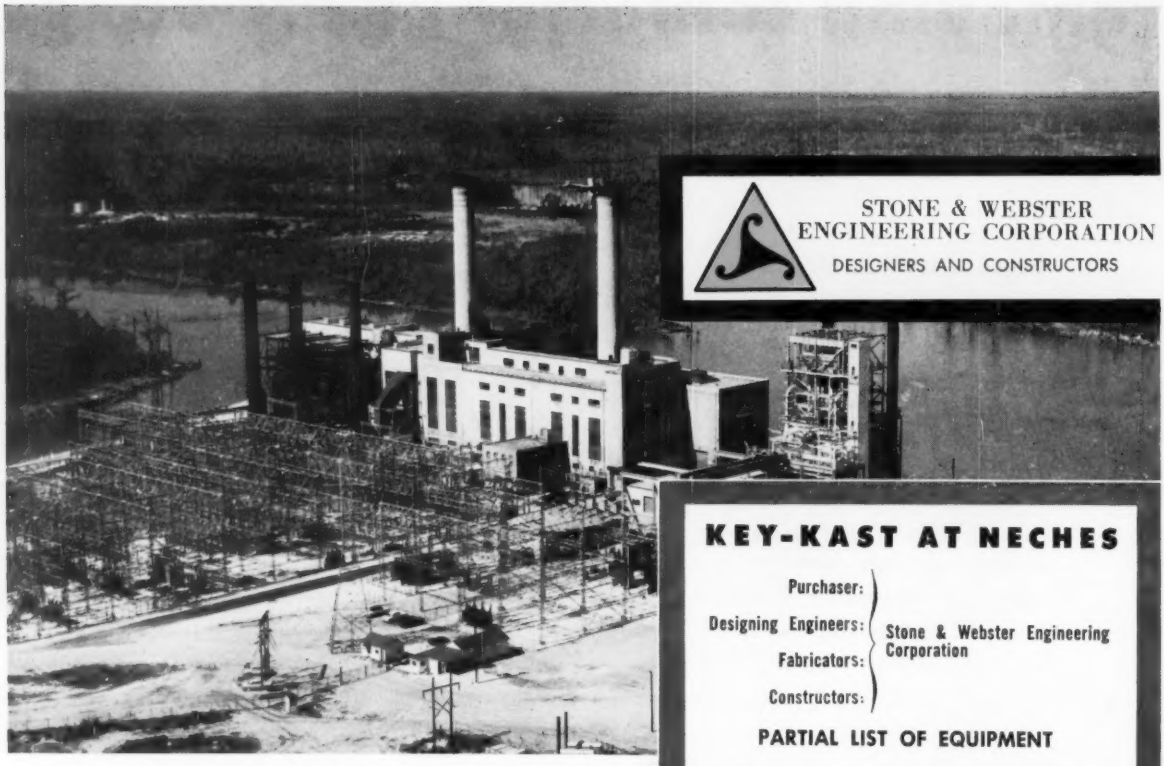
Westinghouse starters combine ease of service with complete, *proven* 3-way protection: system fault protection, motor protection and personnel protection. For all the facts about AMPGARD call your Westinghouse sales engineer or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

*Trade Mark
J-22026

YOU CAN BE SURE...IF IT'S Westinghouse



In the Type H air-break contactor, powerful dual blowout coils get arcs off the solid copper contacts and into the arc boxes immediately. There they are split, stretched and cooled between zircon refractory plates for unequaled arc quenching action . . . much longer contact life and trouble-free operation.



STONE & WEBSTER
ENGINEERING CORPORATION
DESIGNERS AND CONSTRUCTORS

Neches Power Station, serving the fast-growing Orange-Beaumont, Texas, Industrial and Ship Building Region.

KEY-KAST CARRIES 700,000 P.P.H. STEAM AT NECHES POWER STATION ADDITION

KEY-KAST* Alloy Steel Welding Fittings safely channel main and reheat steam flow from the new 700,000 pounds per hour boiler for the 111,000 kilowatt turbine generator unit at the Neches Power Station of Gulf States Utilities Company.

KEY-KAST Fittings are designed by specialists in fluid flow to give you the most desirable shape and longest lasting steel alloys to move your lading safely and efficiently. Available in all standard shapes, sizes and schedules . . . or especially designed to meet particular conditions of pressure, temperature and lading.

When you need alloy steel welding fittings . . . for new or replacement installation . . . call your KEY-KAST engineer for prompt, experienced service in selecting the KEY-KAST fitting best for you.

For more information about KEY-KAST, Write Dept. L-10 for Bulletin KK-1057.

W-K-M
DIVISION OF acf INDUSTRIES INCORPORATED

PLANT: MISSOURI CITY, TEXAS
MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

KEY-KAST AT NECHES

Purchaser:
Designing Engineers:
Fabricators:
Constructors:
} Stone & Webster Engineering Corporation

PARTIAL LIST OF EQUIPMENT

KEY-KAST 90° Reducing Welding Elbow

Material: 12¾" x 9.3" O.D. 2¼% Chrome, 1% Moly, ASTM A-217 Grade WC9
Temperature: 1000° F.
Pressure: 1695 psig
Service: Main Steam

KEY-KAST 90° Welding Wye

Material: 18" x 12¾" x 12¾" O.D. 2¼% Chrome, 1% Moly, ASTM A-217 Grade WC9
Temperature: 1000° F.
Pressure: 550 psig
Service: Reheat Steam

KEY-KAST Concentric Welding Reducer

Material: 10¾" x 9.3" O.D. 2¼% Chrome, 1% Moly, ASTM A-217 Grade WC9
Temperature: 1000° F.
Pressure: 1695 psig
Service: Main Steam

KEY-KAST 90° Welding Wye

Material: 12¾" x 9.3" x 9.3" O.D. 2¼% Chrome, 1% Moly, ASTM A-217 Grade WC9
Temperature: 1000° F.
Pressure: 1695 psig
Service: Main Steam

*KEY-KAST is a trademark of acf Industries, Incorporated

MANUFACTURERS OF W-K-M GATE VALVES acf LUBRICATED PLUG VALVES KEY-KAST ALLOY STEEL PIPING FITTINGS KEY RETURN BENDS AND FITTINGS

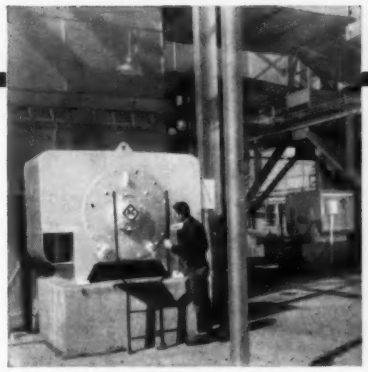
5722

One of many reasons why **ALLIS-CHALMERS MOTORS** are preferred for outdoor applications for

POWER PLANTS

Space Heater is weather protected

(und corrosion-proof!)



Weather protected motor drives force draft fan.

Weather-protected heaters are standard on Allis-Chalmers outdoor motors . . . prevent moisture condensation on motor parts during shutdown periods. These immersion-type heaters are not only waterproof, they are also stainless steel clad for resistance to corrosion.

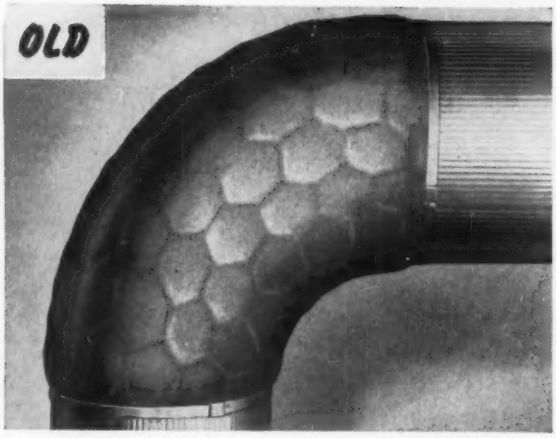
Easy Maintenance, too!

Heater terminal box mounts outside motor frame; heating element projects into motor enclosure. Open wiring inside motor is eliminated. Entire heating unit is easily removed for service or replacement.

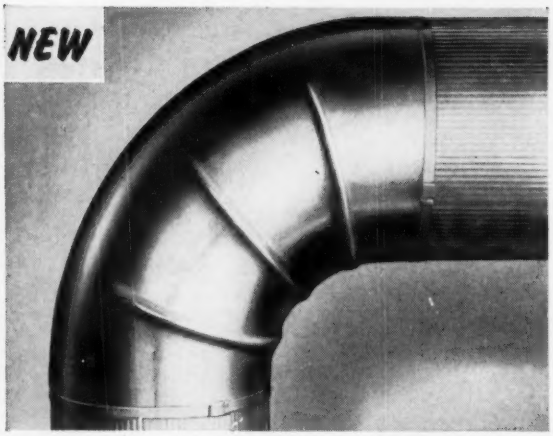
For details on this and all the other outstanding features of Allis-Chalmers motors, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwauke 1, Wisconsin.

A-C ALLIS CHALMERS **ALLIS-CHALMERS**

A-5491



UGLY, COSTLY CHICKEN WIRE AND MASTIC elbow coverings like this are now obsolete. New Childers Aluminum Ell-Jacs end the need for slow, costly hand-made "patches". Childers Ell-Jacs keep their new look, never need expensive periodic painting or maintenance.



NEW CHILDERS ALUMINUM ELL-JACS now make possible neat, weather-tight aluminum protection from one end to the other of your insulated lines. Childers Ell-Jacs are precision formed for long-radius 90° and 45° ells and have factory-applied moisture barrier.

Childers Announces New Aluminum Elbow Jacketing For Insulated Lines

Revolutionary new Childers Ell-Jacs go on fast and easy . . . fit perfectly . . . cut installation costs . . . never need painting . . . and, used with Childers Jacketing, give your insulated lines that well-dressed look from end to end.

Childers Ell-Jacs, together with Childers Jacketing, enable you to install maintenance-free aluminum over every square foot of your valuable insulation. You protect *all* of your insulation investment at lowest cost. You get the bonus of a better looking plant and easier housekeeping. Aluminum *keeps* its new look, needs no expensive periodic painting.

Leading power plant engineers report that insulation on steam lines *lasts far longer* when protected with Childers Aluminum Jacketing. Childers Jacketing protects the insulation indefinitely against damage from workmen, equipment, and dripping fluids like oil and grease.

You can reduce heat loss by radiation, too, when you use Childers Jacketing on power plant lines and insulated equipment. This means increased efficiency and lower fuel costs.

Positive weather-proofing, too, is assured by exclusive Childers Lap-Seal (Patents Pending). Factory-attached moisture barrier prevents harm to the underneath side of the aluminum.

You also get greater strength and greater protection because Childers Jacketing is cross-crimped.

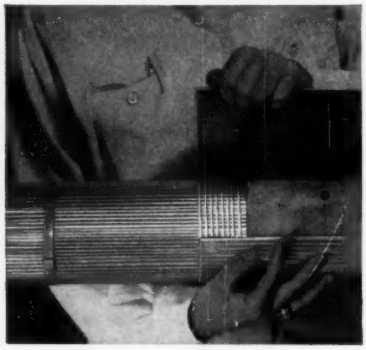
First cost is less for Childers Jacketing than for any other permanent type weatherproofing—even less than some temporary coverings.

It's easy to install Childers Jacketing. All you need are pliers and screwdriver, plus inexpensive strapping. Two men can do the job. Jacketing can be removed to inspect lines, then reapplied without waste.

Childers Engineering Representatives in 27 cities provide technical information and assistance on the protection of insulated lines, elbows, towers, vessels and tanks. Only Childers has this nationwide service organization.

For a free sample of Childers Aluminum Weather-proof Jacketing, with engineering data on how to safeguard your insulation, write to Childers Manufacturing Company, Dept. P-16, P.O. Box 7467, Houston 8, Texas.

See our ad in Sweet's Industrial Construction File, Chemical Engineering Catalog and Refinery Catalog.



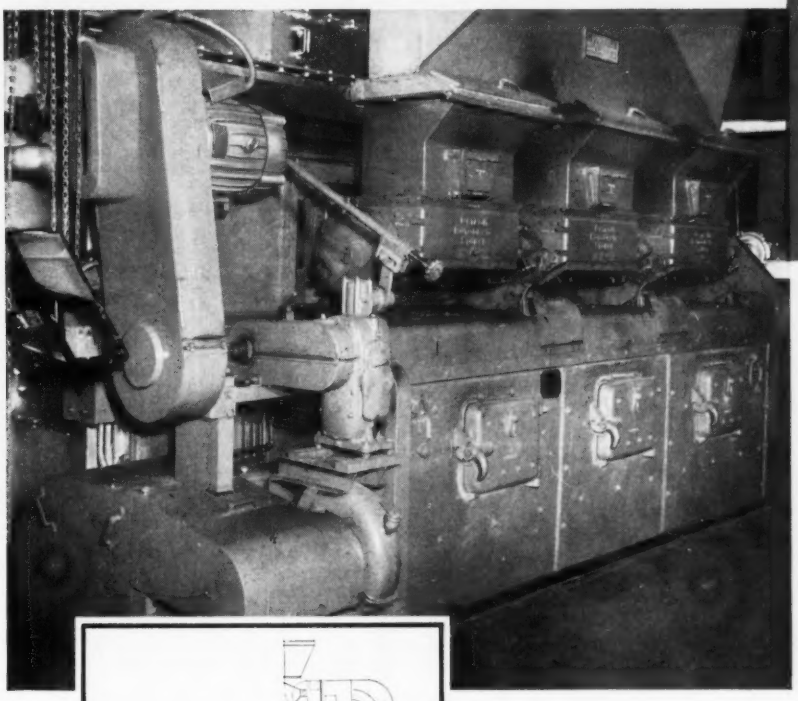
EXCLUSIVE LAP-SEAL, available at no extra cost, is a series of 8 ribs rolled into the underlapping edge of the jacketing, providing automatic measure of the 2" circumferential lap. Proper lap is assured without waste. Labor is saved. Where desired, a positive weather seal is easily made with Lap-Seal and a mastic.

CHILDERS HEAVY WEIGHT aluminum jacketing is recommended for extra protection of lines along walkways and other areas subject to physical abuse. Also recommended for protection of insulated towers, vessels and tanks. Comes in labor-saving 4' wide rolls.

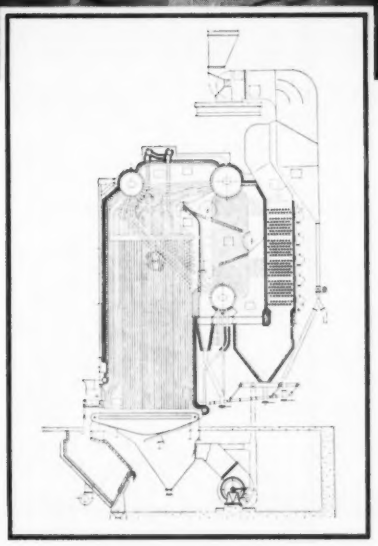
Availability?...

HERE'S A RECORD TO SHOOT AT.....Only

5 HOURS OUTAGE in 5 years



A Detroit RotoGrate Stoker



AT OTSEGO

Detroit RotoGrate Stoker with Wickes Boiler; 650 pounds pressure, 750°F temperature. Cummins & Barnard, Consulting Engineers.

This record of only 5 hours outage in over 5 years is reported by Otsego Falls Paper Mills, Otsego, Michigan, a division of Menasha Wooden Ware Corporation.

Walter Boettcher, Chief Power Engineer says: "*5 hours in 5 years and 4 months is the record of down time due to the RotoGrate Stoker outage*" in this well operated single boiler plant.

"*It operates 24 hours a day—5 to 6 days a week, 60,000 to 90,000 pounds of steam per hour.*

"*Paper mill load fluctuations handled easily without pressure loss.*"

This record indicates a fine job of equipment maintenance, but high availability can be taken for granted with the DETROIT ROTOGRATE.

A customer survey taken in all kinds of plants proves it.

DETROIT ROTOGRATE COSTS LESS

Cost = initial investment + upkeep + production losses due to outage of equipment. The total is less with RotoGrate.

DETROIT SINCE 1898 STOKERS

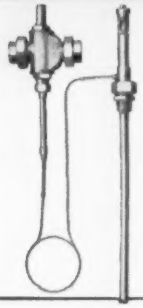
DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

Low-cost Temperature Control — by SARCO

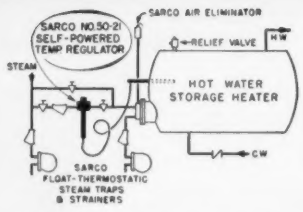
Self-Powered and Electric Indicating



Sarco Temperature Controllers Self-Powered . . . Fully Modulating

Simple as ABC . . . a thermostat with capillary tubing and a valve. That's all! Operated by liquid expansion. Automatic. Self-powered . . . no electricity or compressed air required. Self-contained . . . no exposed mechanism. Packless valve . . . no stuffing box to leak or stick. Easy to install by any pipefitter.

Furnished with thermostats suitable for any liquid or for air in dryers, ovens, air ducts, etc. Valve sizes . . . ½ to 6". Temperature ranges to 300°F. *Bulletin 620-2.*

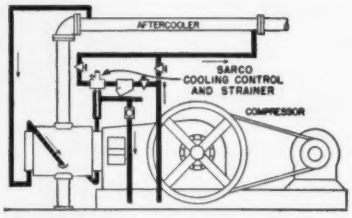


Typical applications: Shell and tube heat exchangers; condensers, oil storage tanks, dryers, etc.

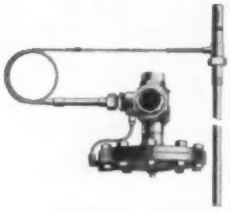
Sarco Cooling Controls Self-Powered . . . Fully Modulating

Simple, compact, automatic thermostatic valve. Eliminates overcooling and undercooling. Saves water. Overall height of ¾" size is only 17 7/16". Self-powered . . . requires no electrical or compressed air hook-up. Valve and bulb all in one unit. No exposed mechanism. Single-seated packless valve . . . not affected by silt or scale-forming minerals.

Valve sizes . . . ⅜ to 1½". Temperature ranges between 40° and 210°F. *Bulletin No. 710-B.*



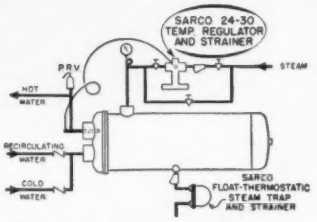
Typical applications: compressors, small engines, water-cooled bearings, condensers, dry cleaning stills, etc.



Sarco Temperature Controllers Self-Powered . . . Single-Seated, Tight-Closing

A simple, self-powered automatic temperature controller with diaphragm-operated, pilot-controlled valve. Designed for intermittent service or service involving long periods with practically no call for steam. Self-powered by liquid expansion . . . no electricity or compressed air needed. Packless.

Valve sizes . . . ½ to 3". Temperature ranges to 300°F. *Bulletin No. 625-B.*

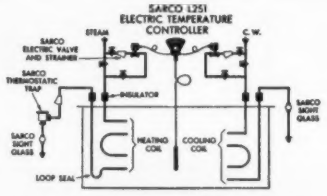


Typical applications: instantaneous heaters, fuel oil pre-heaters, high pressure applications on hot water storage tanks.

Sarco Electric Temperature Controllers Indicating Type

Simple, inexpensive, electric-indicating automatic temperature controller. Sensitive enough to perform many of the functions of much more elaborate recorder-controllers, at a fraction of their cost. Responds to changes of ± ½°F. Adjustable. Large, easy-to-read scale shows both actual and set temperatures.

Temperature ranges between minus 90° and plus 650°F. Offers many sequence combinations such as step-heating. *Bulletin 1025-B.*



Typical applications: plating tanks, processing vats, kettles, chemical tanks, etc.

Sarcostat Hydraulic Motor Valves Electrically Operated

For remote control by hand or thermostat. Open and shut operation. Can be equipped with semi-modulating mechanism. Powerful hydraulic action operates valves up to 5" single-seated, or 8" double-seated, at pressures up to 175 psi. Ruggedly constructed . . . to withstand severe use without constant supervision and with minimum maintenance. Operates in any position.

For direct connection to 110 volts A. C., 60 cycle current. Valve sizes . . . ½ to 5" single-seated; ½ to 6" double-seated. *Bulletin 1080-A.*

UNDIVIDED RESPONSIBILITY

From one "Complete Line" source . . . SARCO-SARCOTHERM . . . for temperature controllers, steam traps and other heating specialties.

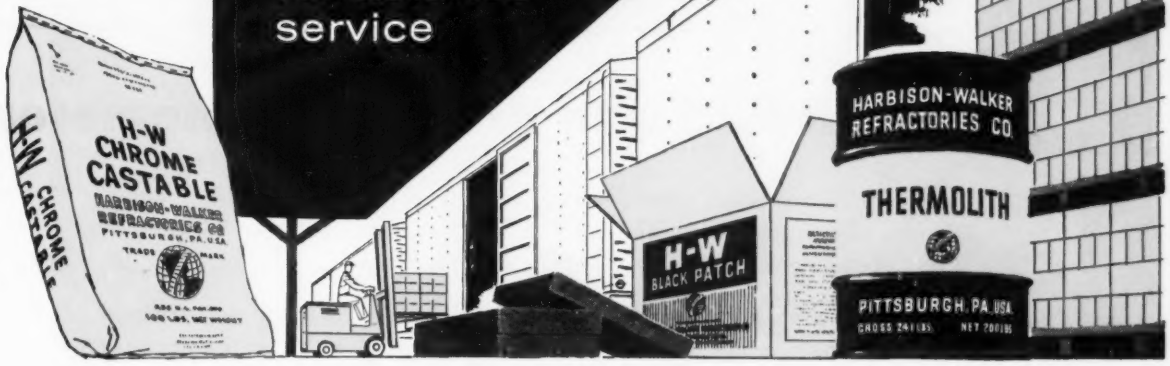
2230-B

Write for Bulletins to—**Sarco Co., Inc., Empire State Bldg., New York 1, N.Y.**

call

HARBISON-WALKER

for a
complete
simplified
refractories
service



ASSURES BALANCED SELECTION

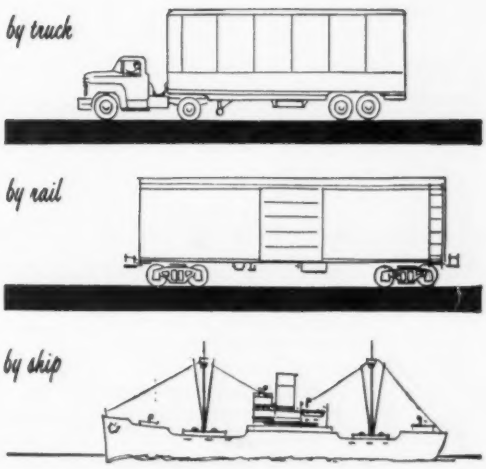
SAVES TIME and MONEY

your call...

to Harbison-Walker can take care of your entire needs. The complete range of H-W products includes prefired and chemically bonded brick and shapes . . . Plastics . . . Castables . . . Insulating materials—in types and classes for *all* service conditions and *all* applications. For whatever you require, one call frequently simplifies your ordering procedures.

single shipments...

often feasible, are both convenient and economical since transportation and handling time and costs are kept to a minimum. And Harbison-Walker's Technical Service Department helps provide for the most advantageous selection of refractories for each specific furnace requirement.



HARBISON-WALKER REFRACTORIES COMPANY
AND SUBSIDIARIES
GENERAL OFFICES: PITTSBURGH 22, PENNSYLVANIA
The World's Most Complete Refractories Service

Versatility...

you'll find it in Brown Thermometers

Here are thermometers versatile enough to be easily adapted to the *exact* requirements of any application, no matter how highly specialized. And they can be just as easily converted from one application to another.

Key to the unusual versatility of Brown thermometers is the broad variety of models, ranges, control forms and accessories available. With such a wide choice of features, you can custom-fit these instruments to any job without compromise.

Use Brown thermometers in the intermediate temperature range, from –125 to 1000 F . . . for measuring, recording, controlling, programming. As many as six separate functions can be combined in one of these thermometers, to reduce instrument costs, centralize control at one location, and save space.

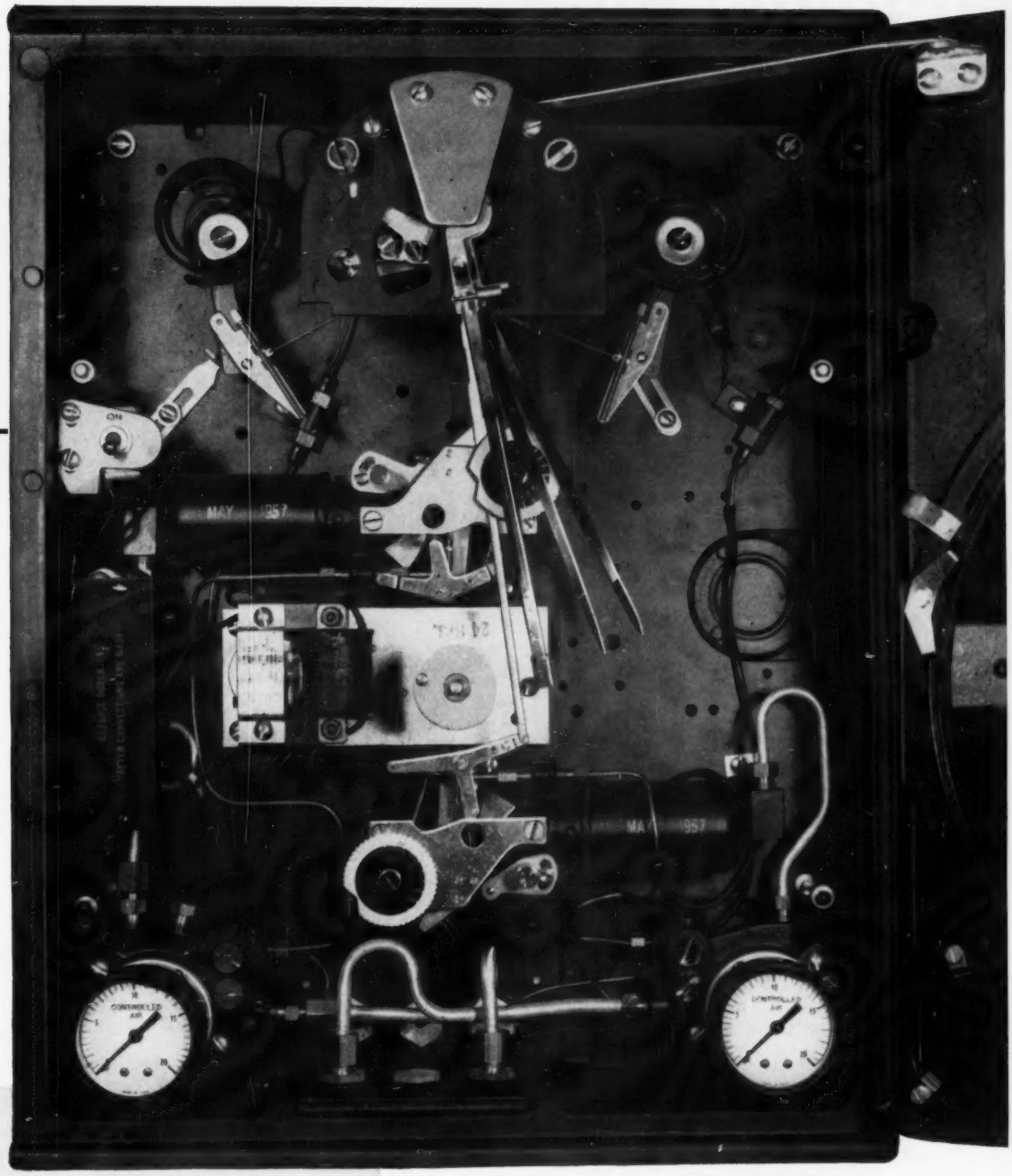
Your nearby Honeywell field engineer can help you gain the many advantages of Brown thermometer versatility. Call him today . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

- 1, 2 and 3 pen recording for temperature, or for temperature and pressure combined.
- Variety of bulb and pressure type thermal elements available.
- Integral cam programmers with one or two measuring systems . . . single, duplex or dual cams and control units.
- Chart drives for 1, 2, 4, 6, 12, 24-hour or 7-day revolution.

PNEUMATIC CONTROL UNITS

- On-Off control unit—two position action.
- *Throttlor* control unit—1 to 10% proportional band with manual reset.
- *Full Throttlor* control unit—1 to 150% proportional band with manual reset. Rate action can be added.
- *Air-O-Line* control unit—1 to 150% proportional band with automatic reset. Rate action can be added.
- *Pneumatic receivers and transmitters* for transmission of measurement by use of air instead of long lengths of sealed capillary tubing. Receiving instrument can be as much as 600 feet distant from point of measurement.
- *Indexet* bellows-positioned set point index—varies position of set point in exact conformity with time-pattern of cam programmer of signal from another instrument.
- *Electr-O-Vane* electric control units—operate valves, heaters, alarms, signal lights, and perform other electrical functions.



IN ONE CASE...

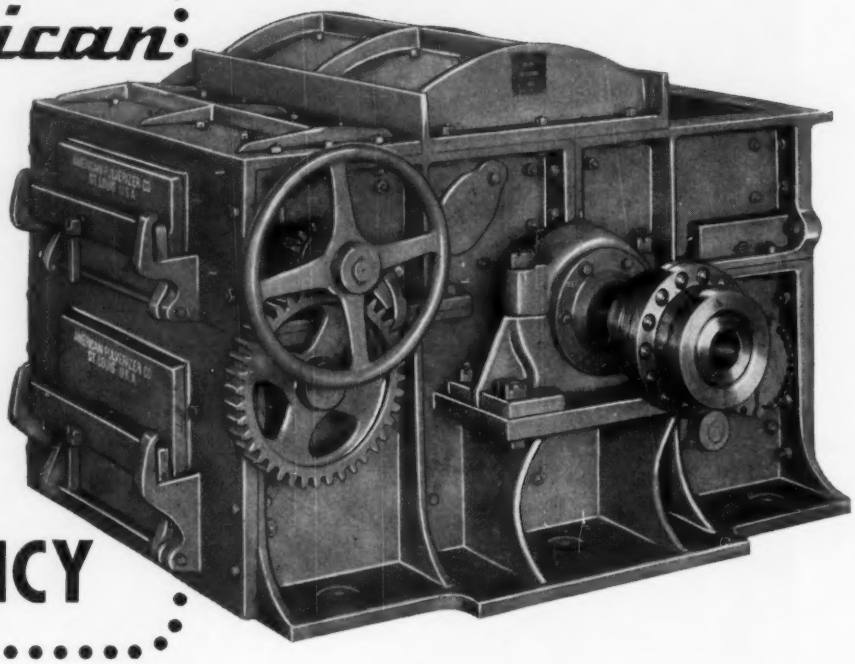
A Brown thermometer with two 10% *Throttlor* control units . . . two pens . . . two bulbs. It can operate two valves or other final control elements.

Honeywell

H HONEYWELL

First in Controls

American Ring Coal Crushers give you EXTRA EFFICIENCY



USER REPORTS:

. . . consistent production 10% above factory rated capacity . . . at only 90% of potential motor load.

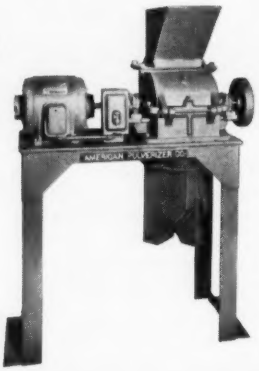
A Southeastern utility reports that their American Ring Coal Crusher, Model AC7C, is reducing 12" ROM Coal to —1" at a rate of 550 tons per hour, compared to the factory rated capacity of 500 TPH. Also, this added capacity is obtained without affecting the power factor.

This means a lot to the Preparation Engineer who knows that he can depend on The American Ring Coal Crusher to handle the surge loads which develop from time to time.

The American-Originated Rolling Shredder Ring Crusher, combining a splitting and crushing action in its operation, is recognized for its efficiency and high over-all quality of performance, making it the leader in the field. "When you figure Cost per Ton—The best results come from American Ring Coal Crushers."

. . . and for efficient coal sample crushing

The American Sample Crusher, with its new Adjustable Sampling Hopper, gives 5%, 10%, 15%, or 20% of a sample . . . in one operation.



If you have a reduction problem, we welcome your inquiry.

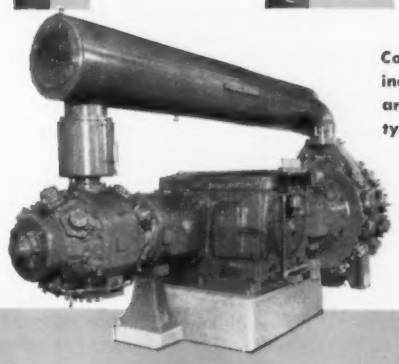
American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

AIR FOR INDUSTRY

Be sure to check on the *new* advantages in low-cost compressor service, packaged simplicity, extreme durability, easy installation and low maintenance, offered by one of America's *oldest* compressor builders. Write for descriptive bulletins . . . or phone Mount Vernon, EX 3-0121.

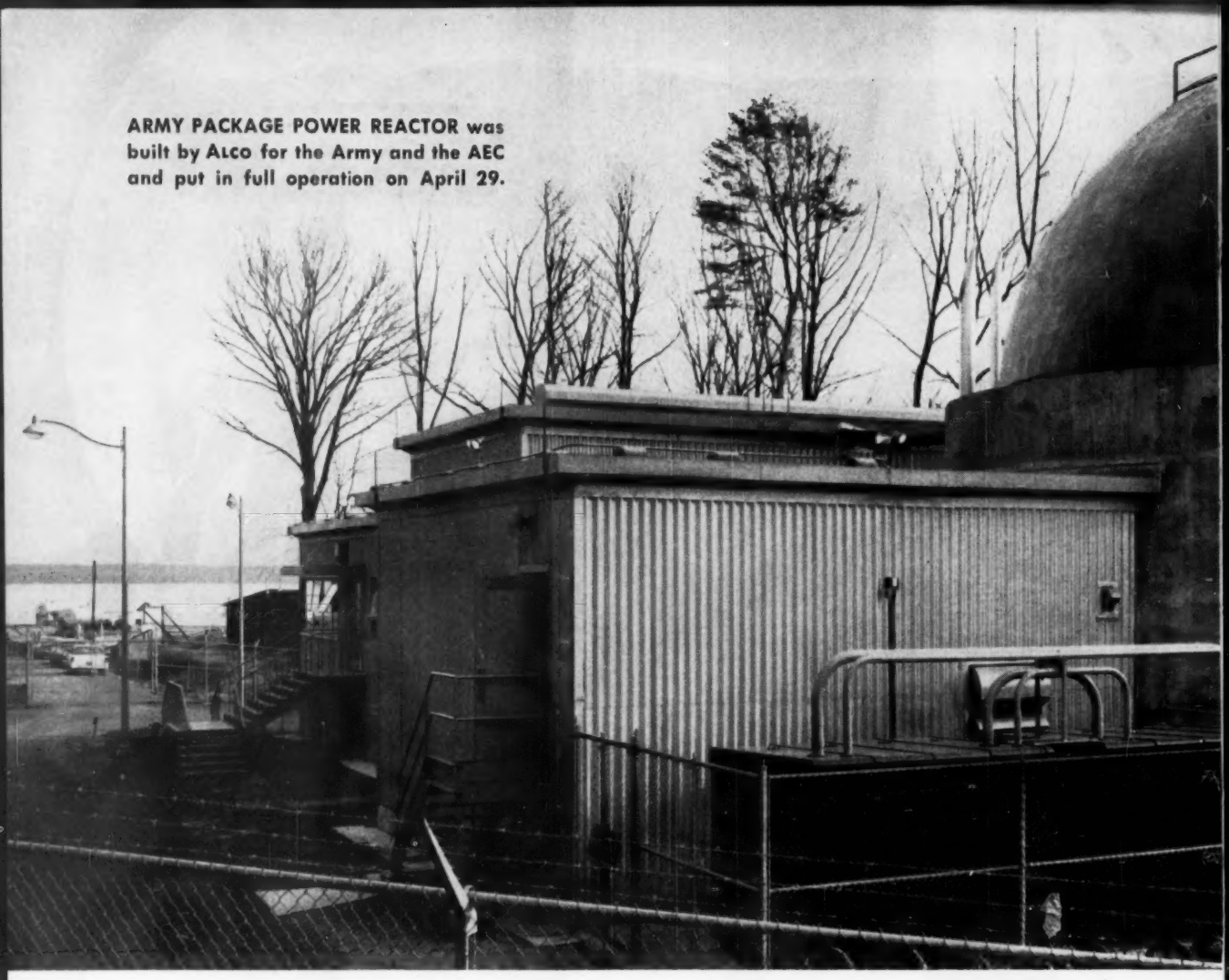


Cooper-Bessemer packaged industrial air compressors are available in four basic types from 200 to 6000 hp

Cooper Bessemer

GENERAL OFFICES:
MOUNT VERNON, OHIO

Engines: Gas • Diesel • Gas-Diesel
Compressors: Reciprocating and Centrifugal, Engine or Motor Driven



ARMY PACKAGE POWER REACTOR was built by ALCO for the Army and the AEC and put in full operation on April 29.

NEW PWR POWER PLANT: POWER FROM

ALCO-built APPR in operation at Fort Belvoir, Va.; non-experimental plant first to generate useful power on land

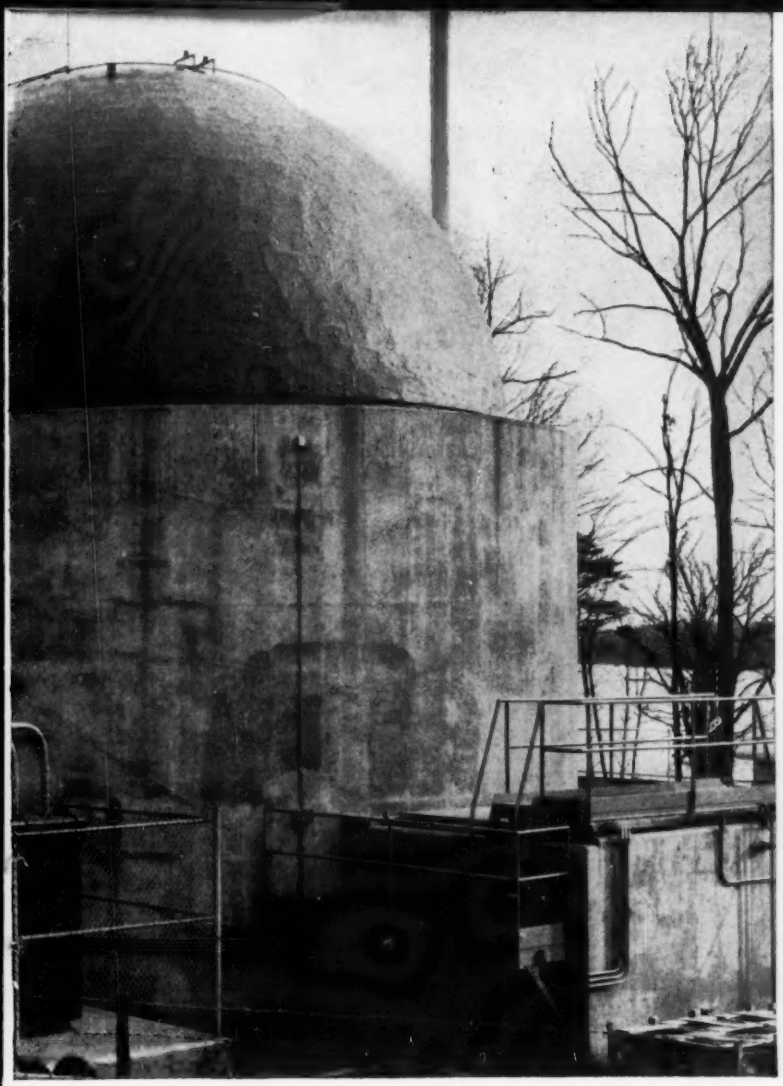
ALCO's Army Package Power Reactor, designed and built for the Army and the AEC, is now in operation at Fort Belvoir, Va., after dedication on April 29 by Army Secretary Brucker and AEC Chairman Strauss. Generating 2000 kw, it is the forerunner of a reactor family designed to provide economical power in areas where the costs of fossil fuels are high. Other PWR reactors, developed to 20,000 kw output from insights provided by the APPR, are now available from ALCO. Their hallmark: The invaluable experience gained by the builder of the first land-based reactor for power generation.

ALCO ATOMIC PLANTS NOT EXPERIMENTAL

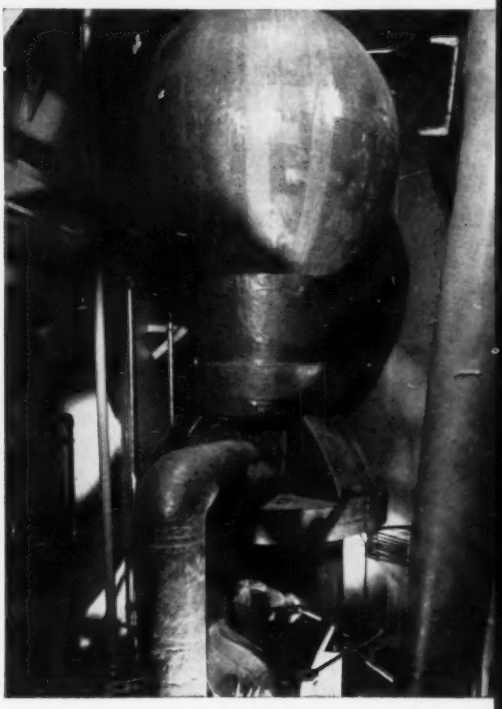
The ALCO PWR plants are not experimental. Their basic design concepts have been proved. In many areas of the U.S. their operation will be economically justifiable in just a few years—perhaps no later than the operation date of a reactor ordered today. ALCO will provide an evaluation of costs, studies of site factors and designs to help you. You may initiate action by writing, on your letterhead, to Atomic Projects, Dept. AE-2, P. O. Box 1065, Schenectady 1, New York.

ALCO NUCLEAR COMPONENTS ALSO PROVED

ALCO designed and built many of the components for the APPR, including the steam generator, pressurizer, feedwater heater and evaporator, control-rod drives and others. ALCO components are also included in the S1W, S2W, S3G, S4G, PWR, EBR and SRE systems. This extensive experience, plus facilities like complete thermal, mechanical and welding labs, and an electronic computer center, established ALCO as a

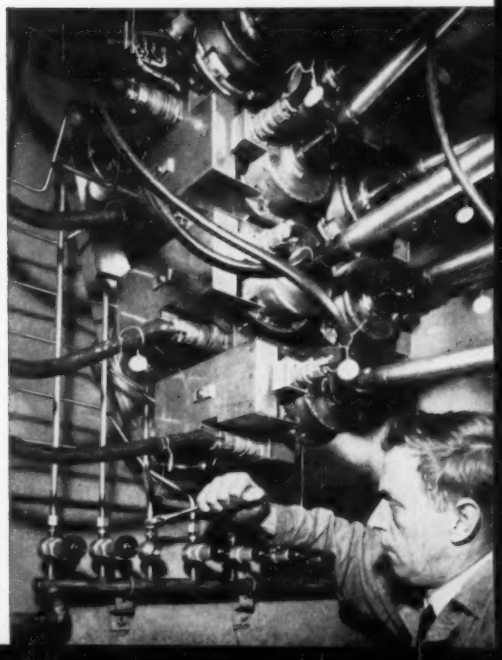


APPR PRESSURIZER was designed and built by ALCO, along with other components in primary loop. ALCO is leading nuclear component manufacturer.



THE ATOM NOW

APPR CONTROL ROD DRIVES, receiving final adjustment by ALCO technician in Fort Belvoir prior to operation, were designed and built by ALCO.



leading supplier of nuclear hardware. Here are some of the components available from ALCO:

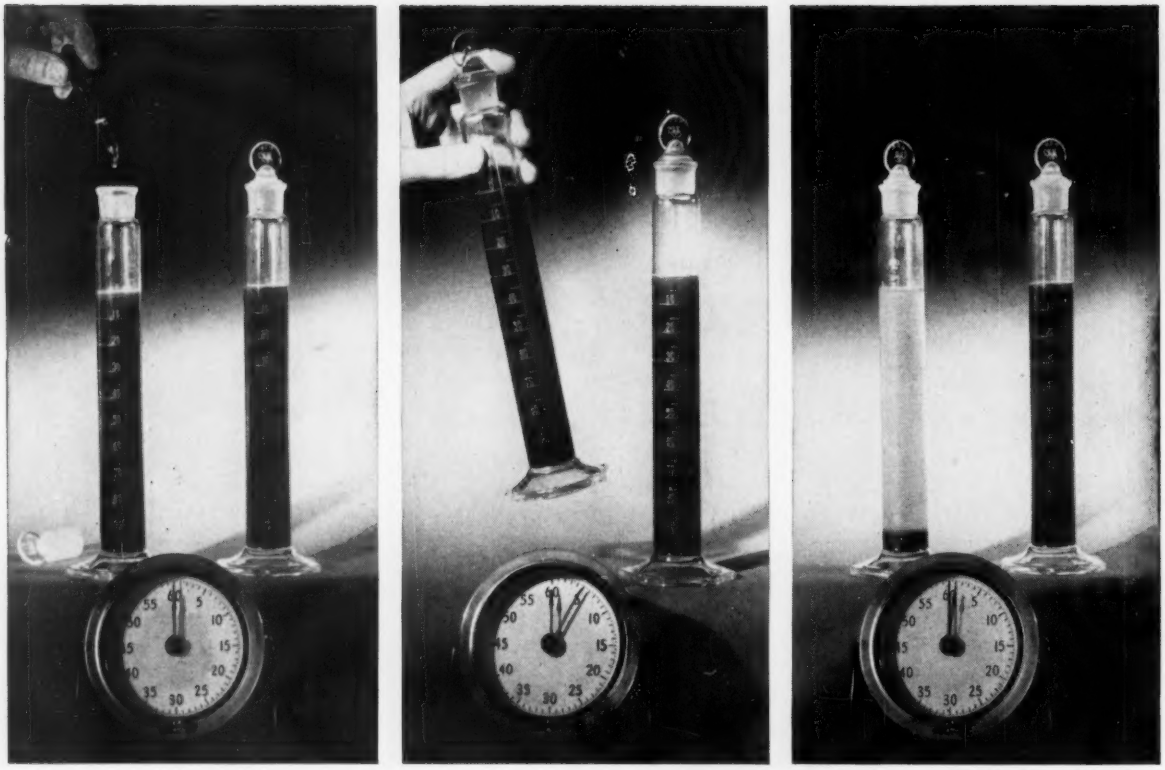
- reactors
- reactor vessels
- control-rod drive mechanisms
- pressurizers
- steam generators
- core support structures
- core removal and handling equipment
- regenerative and non-regenerative exchangers
- liquid metal exchangers
- decay exchangers
- special heat-transfer equipment

ALCO

ALCO PRODUCTS, INC.

NEW YORK

Sales Offices in Principal Cities



Demonstration: Add Separan 2610 . . . mix . . . in a few seconds, solids settle . . . compare with untreated solids.

New flocculating agent Separan 2610 clears process and waste water in record time

New flocculant proves to be faster and more economical answer to many old problems in process water and waste treatment operations. Separan 2610® speeds up settling and filtration rates . . . brings many other improvements to liquid-solid separations!

PROVEN APPLICATIONS

Process water treatment – improves throughput and performance in hot and cold lime softeners, chemical flocculation units!

Sewage–speeds dewatering of digested elutriated sewage sludge!

Oily waste disposal – improves floc blanket flotation on refinery water effluent flotation unit!

Foundry waste–reduces stream pollution and provides cleaner recycle water!

Pulp & paper waste–increases solids recovery, lowers sewer loss!

Coal washing–improves fines recovery, increases throughput of settling unit!

Electroplating–settles solids in combined cyanide, chrome and acid wastes; speeds filtering!

Chemical wastes–improves solids recovery; less material loss!

EXAMPLES OF RESULTS

Separan 2610 was applied at 0.25 ppm to a cold lime softener supplying cooling tower make-up water. The sludge blanket became stabilized, effluent turbidity was reduced from an average 10 ppm to less than 5 ppm, and the unit operates more efficiently. Flocculant savings with Separan 2610 exceed $110 per month on a throughput that averages 900 gpm.

Another plant uses Separan 2610 in dewatering of digested elutriated sewage sludge on vacuum filters. This application has brought a 24% increase in filter capacity and a 20% reduction in total chemical flocculant cost.

In oil refineries, similar improvements are being experienced in flotation units for clarification of combined oily wastes. By adding 0.5 ppm Separan 2610, along with alum, to waste water in a flotation unit, plants have improved floc blanket stability and reduced the oil content of the effluent.

MANY APPLICATIONS HAVE BEEN TESTED

Separan 2610 has shown excellent results in many waste and process water applications. It is an organic flocculating aid that is easy to prepare and apply, noncorrosive, and that presents no hazard in normal handling and industrial use. Samples and technical assistance are available by writing us. For further data, request one of our new booklets on Separan 2610 in "Waste and Sewage", "Water Treatment", "Coal Industry", or "Pulp and Paper". THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. SC1321J-3.

YOU CAN DEPEND ON DOW

O-B VALVES

save production time
repack under pressure . . .

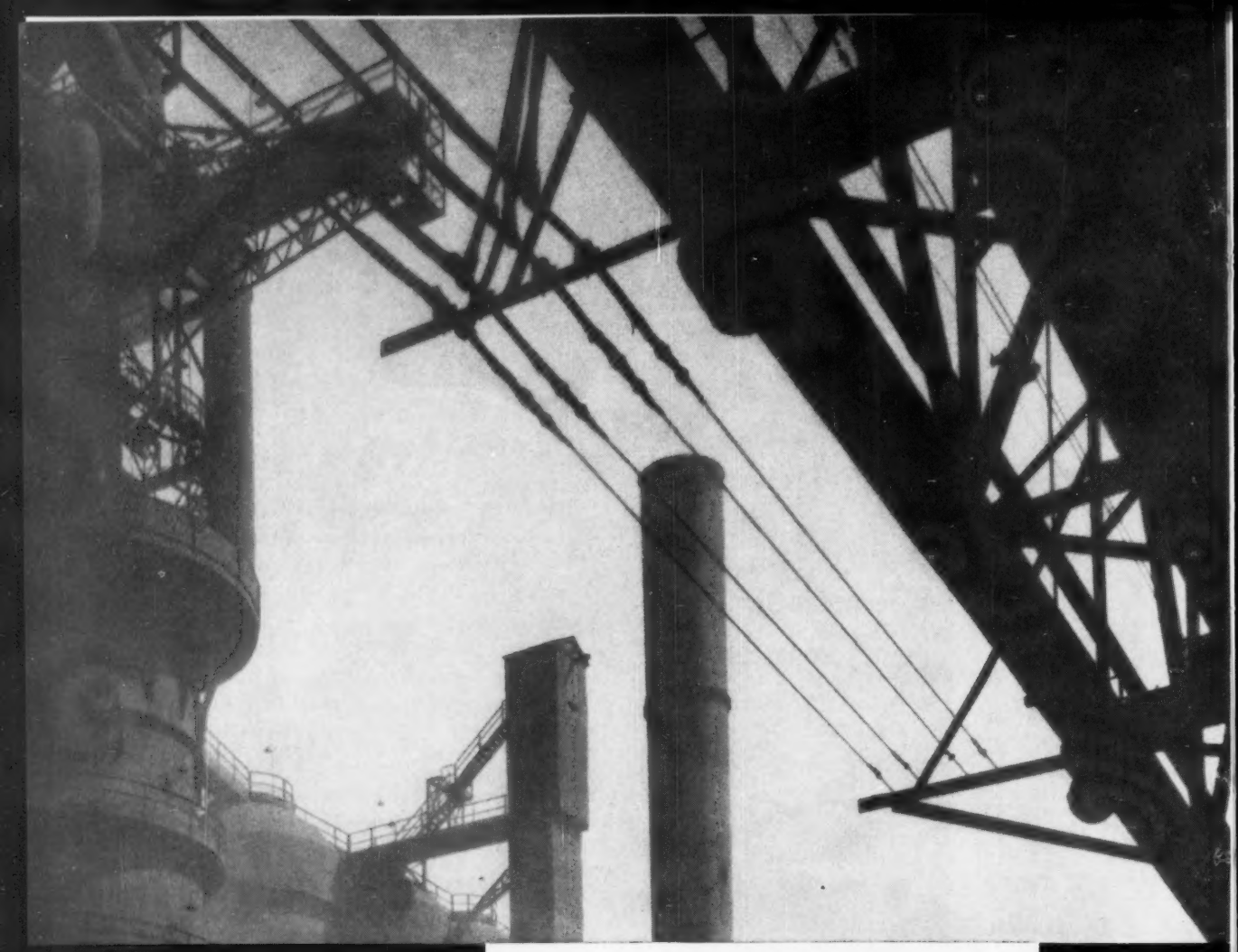
When lost production minutes are counted in dollars, replacing worn valve packing while the line is under full pressure makes sense.

With standard O-B bronze gate and globe valves—125 lbs. WSP and above—production continues without interruption while packing is replaced. Just open the valve full and the special stem design seals pressure within the valve body.

You will find a complete line of O-B valves available from your distributor. Call him today for all your bronze valve needs.

OHIO BRASS COMPANY • MANSFIELD, O.

4722-V



for every temperature range—
for every operating condition

Carey®

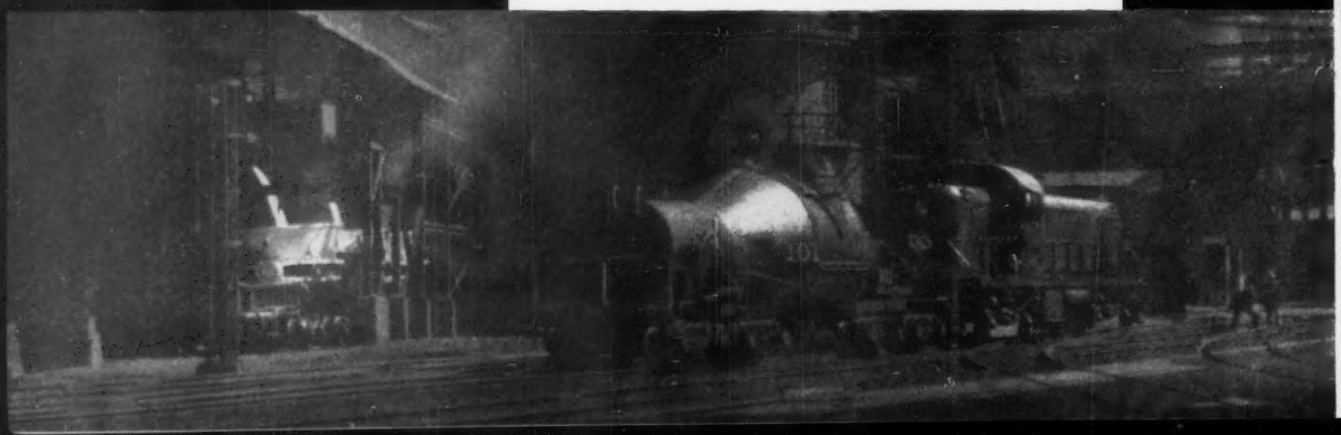
SERVICE-PROVED INSULATIONS

Service Report on Carey Insulations at:

UNITED STATES STEEL CORPORATION

Gary Steel Works
Gary, Indiana

Gary Steel Works is the world's largest producer of raw steel, with an annual steel ingot capacity of 7,187,000 net tons. Its furnaces and mills cover an area of 2,700 acres, including 250 miles of railroad track and 65 miles of roadway. The plant employs approximately 21,000 workers, but its daily power and fuel requirements (2.8 million kilowatts) would amply serve a city of 300,000. Plant facilities include 1,162 coke ovens, 12 blast furnaces and 53 open hearths.



Carey insulations do double duty at world's largest steel mill

In early 1956, the nation's steel companies set for themselves a tough objective—to increase steel capacity by 5 million tons per year through 1958. To help meet this objective U.S. Steel's Gary Works is now in the midst of a multi-million dollar expansion program.

Carey Alltemp and 85% Magnesia insulations have roles in this program. They're helping boost production not only of steel, but of Gary Works' important coke and coal chemical by-products as well. Here's how these tough, dependable Carey insulations are doing *double duty:*

1 at the coke & coal chemical plant...

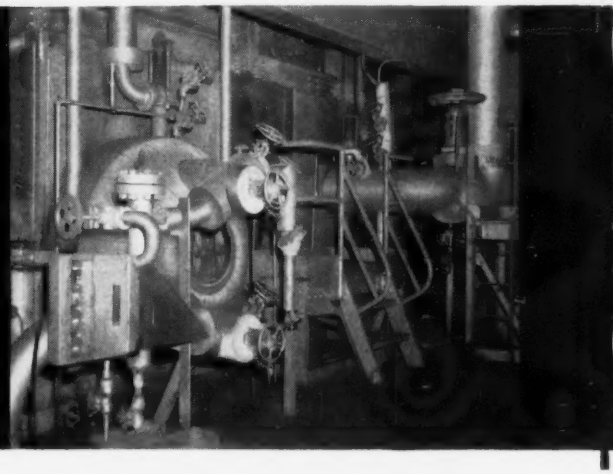
Steelmaking begins here, where coal is made into coke for use in the blast furnaces. Nylons and aspirin tablets are but two of the thousands of chemical by-products resulting from this coke-producing operation. Shown is a small portion of one of the six new boilers which will supply the steam for processing these by-products. They'll do the job formerly done by 18 boilers—a 300% boost in efficiency.

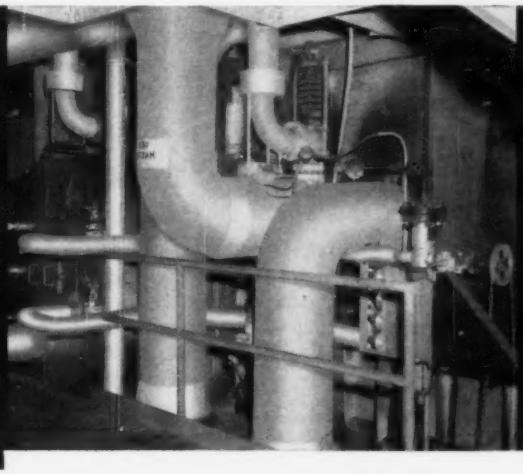
Insulation on two of the boilers is a combination covering of Carey Alltemp and 85% Magnesia. Operation pressure is 900 psi at 825°F. Boiler capacity 100,000 pounds per hour.

2 at the turbo-blower station...

12 blast furnaces produce the molten iron from which steel is made at Gary Works. The ingredients in this process are iron ore, coke and limestone—plus pre-heated air which is blown through the furnace by turbo-blowers.

Supplying steam to the blowers is the job of several giant, 4-story boilers. Pictured above is the steam header over one of the boilers, insulated with Carey Alltemp and 85% Magnesia. Boiler capacity is 250,000 pounds per hour. Operating temperature 850°—steam pressure 650 psi.





The physical characteristics of Carey insulation products are measured and tested with scientific precision by Mellon Institute of Industrial Research, Pittsburgh, Pa. This is your assurance of the accuracy of Carey product specifications. Mail coupon for literature and sample specifications, or for a call from your Carey Insulation Sales Representative.

Better Products for Industry Since 1873

THE PHILIP CAREY MFG. COMPANY

Lockland, Cincinnati 15, Ohio

Insulation Division: Plymouth Meeting, Pa.

THE PHILIP CAREY MFG. COMPANY, Dept. P-107
Insulation Division, Plymouth Meeting, Pa.

Please send literature and sample specifications on

☐ Alltemp ☐ 85% Magnesia

☐ Please have your Insulation Sales Representative call.

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ADDRESS_____

FIRM NAME_____

CITY_____ COUNTY_____ ZONE____ STATE____

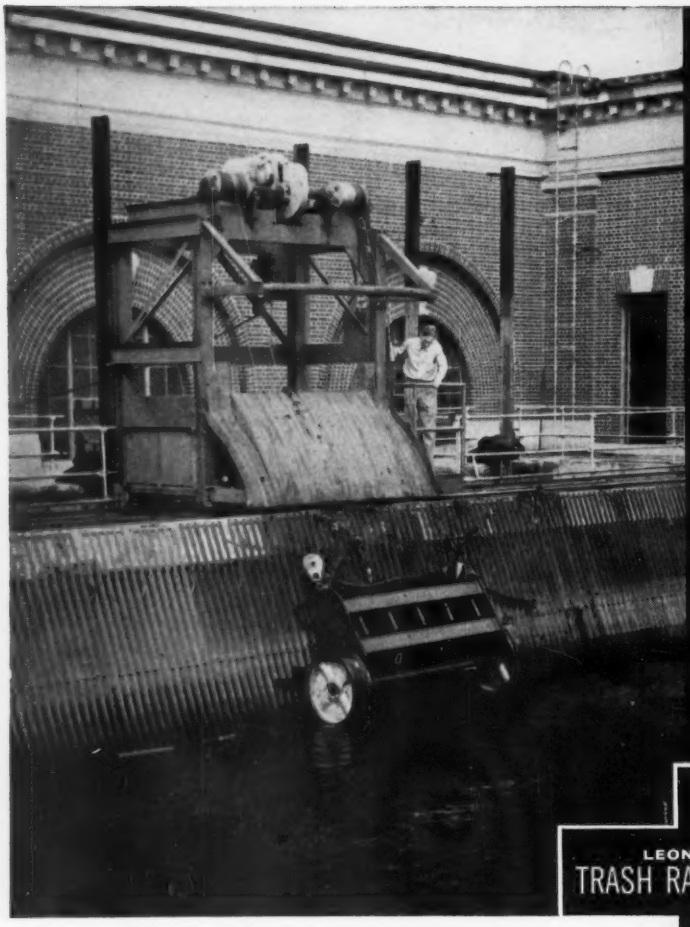
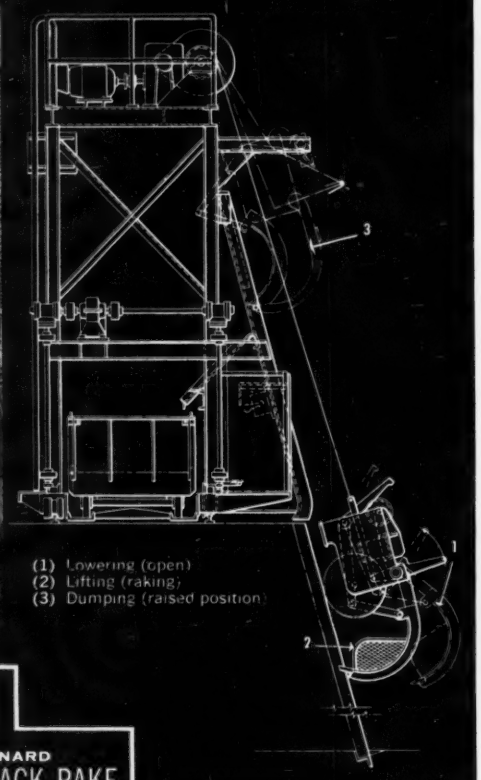


Diagram shows how self-dumping log-grapple rake operates. Note how rake teeth pull into racks and debris when lifting. End screens help retain trash.



(1) Lowering (open)
(2) Lifting (raking)
(3) Dumping (raised position)

LEONARD
TRASH RACK RAKE

New 8-foot, self-dumping SMS rake at Niagara Mohawk Power Corporation's Black River Station is one of five recently installed by this company.

Two New Self-Dumping SMS Trash Rake Designs CUT CLEANING TIME AND LABOR

Now SMS offers you two improved Leonard trash rack rakes, both regular and log-grapple types. These self-dumping rake designs make operation easier and quicker, permit you to clean a greater area faster. Both new rake types are now available as additions to the SMS line of standard rake designs.

SMS Leonard rakes operate directly on trash rack bars . . . ride down over stubborn obstructions and work them loose. Such freedom of movement assures fast, easy cleaning. Initial costs are low because the width of SMS rakes can be kept to the minimum required for handling for trash and the expense of guides attached to racks, or embedded in piers is eliminated. These rakes are of simple and rugged construction, designed for outdoor service and require minimum maintenance.

For full information on trash rakes and other SMS accessories, write to S. Morgan Smith Co., York, Penna. Request Bulletin 158 on Leonard rakes, or Bulletin 158A on new, self-dumping rakes.

S. MORGAN SMITH HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

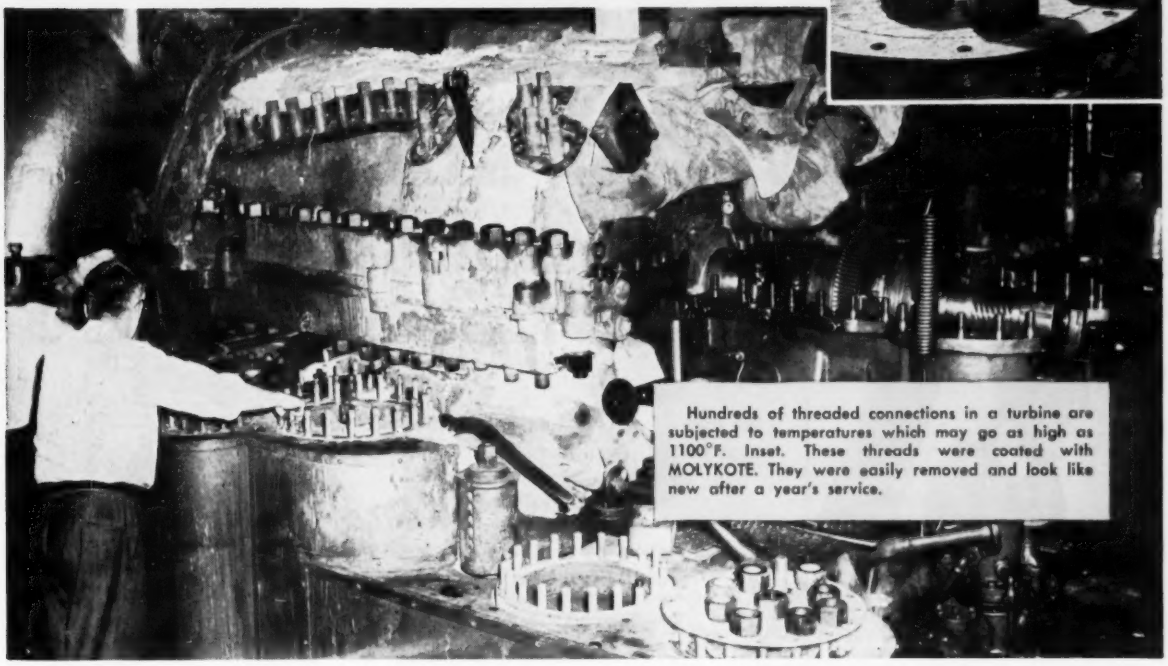
practically

100% PROTECTION...

AGAINST GALLING AND SEIZING OF THREADED CONNECTIONS

WITH

MOLYKOTE® LUBRICANTS



Hundreds of threaded connections in a turbine are subjected to temperatures which may go as high as 1100°F. Inset. These threads were coated with MOLYKOTE. They were easily removed and look like new after a year's service.

Every power engineer realizes that the extreme pressure in threaded connections is carried at a series of contact points on the mating surfaces . . . the number of contact points increasing with load. Since these points of contact are not spaced symmetrically about the thread circumference, off-center loads increase the severity of the contact pressures and frictional conditions.

Liquid lubricants are ineffective under these load conditions and seizing and galling often occurs when make-up or break-away torque is applied.

MOLYKOTE Lubricants exhibit the lowest coefficient of friction of all solids at extreme bearing pressures and offer the highest resistance against galling and seizing. Because of their strong affinity for attachment to metal, they cannot be wiped off. MOLYKOTE used in threaded connections, remains effective at temperatures in excess of 1100°F.

The annual saving which MOLYKOTE Lubricants make possible in the elimination of damage to threaded connections runs into fantastic figures.

Send for Field Reports 9, 19, 30 and 46; Lubrication Newsletter #2, and "Breaking Lubrication Barriers".

The **ALPHA-MOLYKOTE** *Corporation*

Main Factories: 65 Harvard Ave., Stamford, Conn.
71 Arnulfstrasse, Munich 19, Germany

sure
they all look alike...

but it's easy to pick the BEST Heat Exchanger Tube for your job...

Like many "specification" products, different brands of heat exchanger tube may look alike . . . yet still show wide variation in performance.

A great many factors are involved, from uniform chemical composition and inherently sound metal in the alloy to the condition of surface finish on the tube.

One sure way to save time and trouble is to "put it up to Scovill." Scovill Technical Service is one of the most experienced in the field, with a long record of successful applications. Unique Scovill production advances, such as Continuous Casting (of Phosphorized Admiralty), are plus values that cost you no more . . . yet surely pay out in tube performance.

Scovill Manufacturing Company, Mill Products Division,
99 Mill Street, Waterbury 20, Connecticut.
Phone Plaza 4-1171.

simply put it up to... **SCOVILL**

HEAT EXCHANGER TUBE FOR APPLICATIONS FROM MARINE TO PETROCHEMICAL...
FROM COMPRESSOR INTERCOOLERS TO "CAT-CRACKER" EXCHANGERS . . . IN THESE POPULAR ALLOYS
Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Naval Brass • Red Brass, 85% • Deoxidized Copper
Arsenical Copper • Cupro-Nickel 10%—20%—30% • Aluminum Brass • Aluminum Bronze, 5% • Muntz Metal • Duplex Tube

17SC57

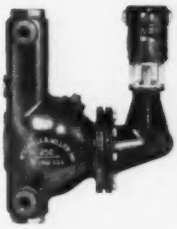
For jobs like these...

Choose from this McDONNELL Line-up

- Boiler Feed Pump Control
- Low Water Fuel Cut-off Switch
- Low Water Alarm Switch
- High Water Alarm Switch
- Electric Valve Control
- High and Low Level Tank Control

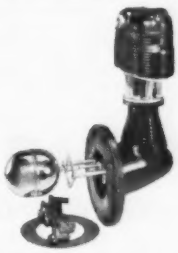
No. 92—For any size boilers or tanks with pressures up to 250 psi. Installed with top and bottom equalizing piping. Used on boilers equipped with separate water column.

No. 192—For fire-tube boilers with pressures up to 250 psi. Has integral water column for gauge glass and try-cock trim. Holds minimum efficient water level.



No. 292—For water-tube or high set boilers where more visible water in gauge glass is desired. Has integral water column. For pressures to 250 psi.

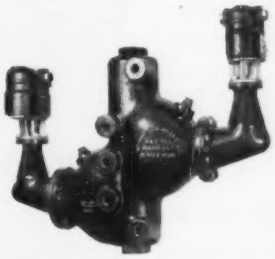
No. 92A—Has lower side equalizing connection. Same features as all 92 Series: operating levels easily adjusted, ample float clearance, low switch terminal temperature, etc.



No. 92-HD—For flange mounting on tanks or water columns. For pressures up to 250 psi. No. 91-HD also available for pressures up to 150 psi.

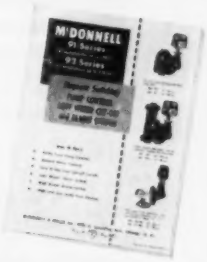
No. 91—For any size boilers or tanks with pressures up to 150 psi. Used on boilers equipped with separate water column. Same repulsion magnetic switching for positive operation.

No. 191—For boilers up to 150 psi. Integral water column. All 91 and 92 Series controls have two single-pole double-throw switches. Ideal for motor operated valve control.



No. 291—For applications requiring very wide operating differentials. Pressures to 150 psi. Commonly used with duplex pumping arrangements.

Write for Bulletin L-123



Has the whole story of the McDonnell 92 and 91 Series controls in a boiled-down usable form. Contains service recommendations, installation drawings, wiring diagrams, etc.

Underwriters Listed • C.S.A. Approval No. 5545.

McDonnell & Miller, *Inc.*, 3506 N. Spaulding Ave., Chicago 18, Illinois

Your Jobber Stocks Them

Doing One Thing Well

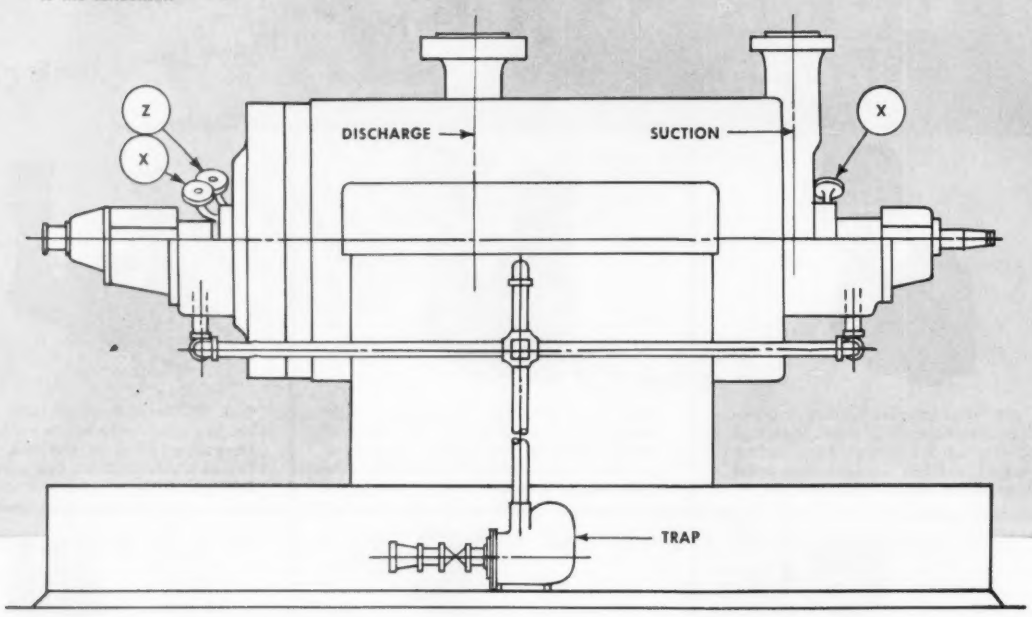
McDONNELL Boiler Water Level Controls and Safety Devices

Arrangement of packingless sealing shows low-maintenance provisions. Condensate is piped to each stuffing box through line X. Condensate flows through an inner and then an outer serrated bushing. Drip catcher gathers condensate at each end — permits condensate to flow by gravity to a collecting trap. Condensate leakage is drawn back into the system by means of a condenser vacuum. Where no vacuum is present, an overflow pipe keeps leakage from entering the bearing bodies.

Line Z takes the high pressure bushing leakage back to the pump suction or to a heater. A needle valve following the trap will control flow back to the condenser.

Optional Sealing Arrangements

In addition to packingless seals, Allis-Chalmers offers standard packing, condensate bleed-in bleed-off arrangement, or mechanical seals — depending on your specific requirements.



PACKINGLESS SEALS

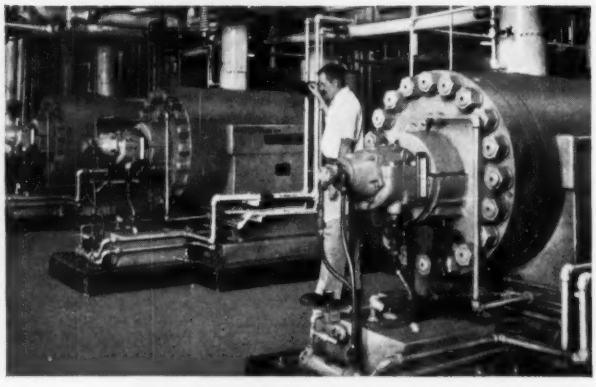
in ALLIS-CHALMERS barrel-type pumps

require no operator maintenance

Proven by performance in numerous power plants, the packingless seal arrangement available in Allis-Chalmers pumps means new station-operating economies. Here's why:

- Operator maintenance of stuffing box eliminated.
- No cooling water required for jacket and gland.
- Selection of smaller heater drain pumps often permitted.

Coupled with this low-maintenance design is the ultimate in efficiency that makes A-C barrel-type boiler feed pumps the most modern power plant pumps available. Contact your A-C representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



ALLIS-CHALMERS

A-5544

LOUIS N ROWLEY, EDITOR • OCTOBER 1957 • ESTABLISHED 1882 Power

Everybody's problem—and nobody's?

CORROSION is a problem—big or little—in every corner of industry. Yet, just because it is so much a matter of concern for everyone, it is rarely a matter of overriding importance to any single organization.

This doesn't mean that nothing is being done about it. Manufacturers of corrosion-resistant materials and protective coatings have done much valuable testing and research. This is equally true of water-treatment specialists and a host of others. But in the nature of things, such investigations, to be economically practical, must shoot for immediately useful results. And so, after years of living with corrosion, we find ourselves still short of true scientific understanding of the fundamental processes, still largely dependent on empirical "rule of thumb" solutions to corrosion problems.

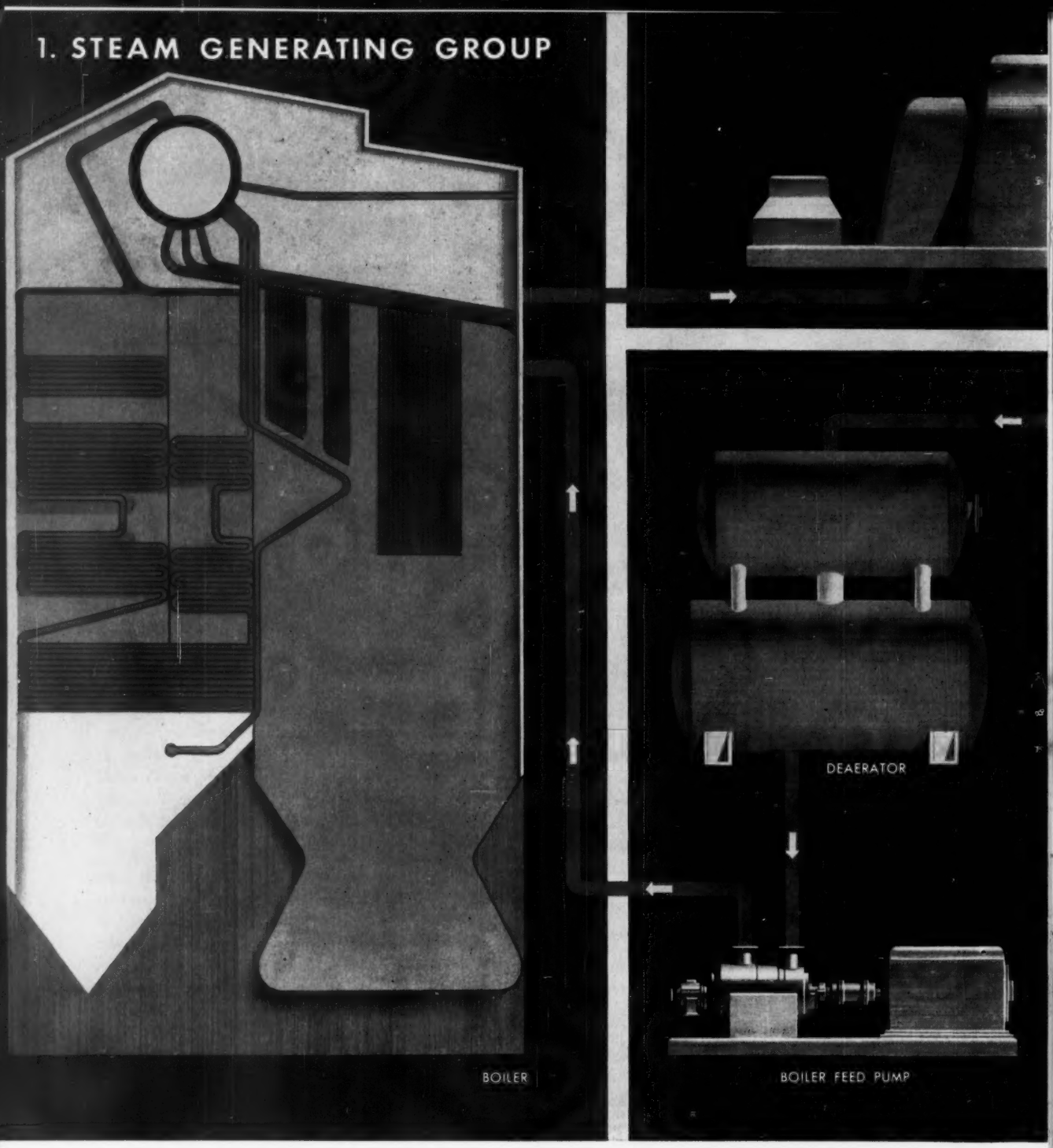
To give just one example: We've made real progress in controlling corrosion of buried pipelines by cathodic protection, but we still don't fully know how and why it works. Nor do we know much about how to fix the exact amount of current needed, or how to tell if we are getting the desired protection. We may control cathodic protection by potential measurements, but we can't be sure just what we are measuring or what our measurements mean in precise terms.

What fundamental information we do possess has resulted from isolated research projects, or as byproducts from programs aimed at some immediately useful result. This knowledge is just as good as that obtained any other way, but it accumulates slowly and haphazardly. Certainly, we can't count on unrelated activities of this kind to give us, quickly and surely, the answers we need to solve corrosion problems on a truly scientific basis.

Aside from a government-sponsored program, the road to a fundamental understanding of corrosion processes inevitably lies in a pooling of industry resources. Such a combined attack could yield a total effort of the magnitude necessary while requiring only modest investment of time and money by individual organizations.

The Corrosion Research Council of the Engineering Foundation has been established to provide the mechanism for such a co-operative activity. It is prepared to set up research projects on its own account, or in joint sponsorship with specific industries or agencies. All projects benefit from the guidance and co-ordination provided by the Council's advisory committees.

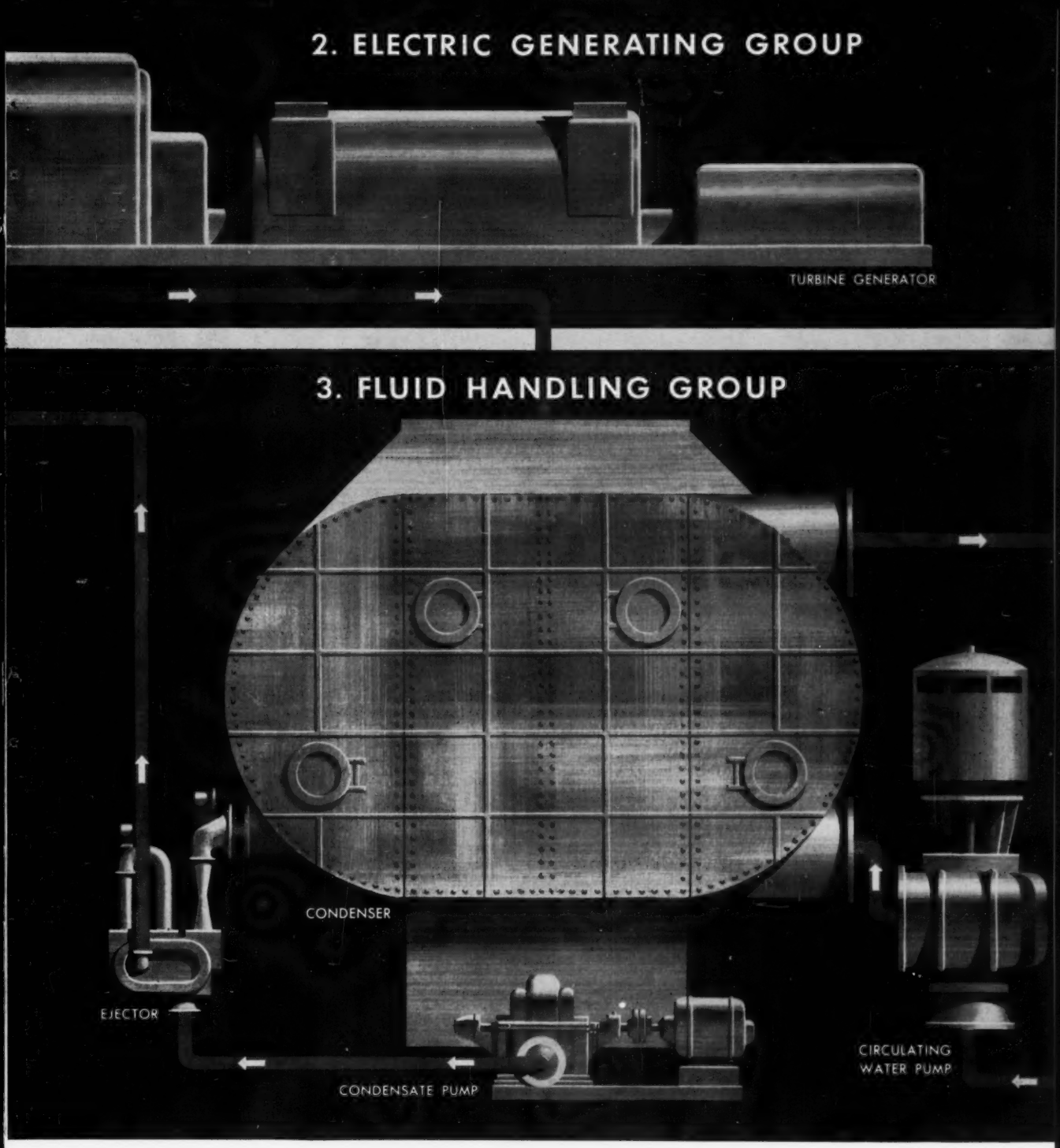
If you have an interest in corrosion and recognize the advantages of a co-ordinated, co-operative effort, you will want to know more about the Council and have a part in its work. Write to Frank Sisco, Secretary, Corrosion Research Council, c/o Engineering Foundation, 29 West 39th Street, New York 18, N. Y. He'll be glad to tell you how your company or industry association can co-sponsor a project of mutual interest, or can contribute in a variety of ways to the work of the Council.



Look at all three

A new steam station design approach is bringing higher efficiencies, lower costs, and greater reliability. In this approach, only three basic functions are considered: (1) Steam Generating, (2) Electric Generating. (3) Fluid Handling. Station requirements are first analyzed in terms of the over-all job performed by each of these groups rather than by each individual piece of equipment.

Many of the benefits of this approach occur in the Fluid Handling Group. Here coordination and integration of the wide variety of equipment used can often effect substantial improvement in over-all operation. As steam temperatures and pressures go up, there are increased demands on the fluid handling function. Plant reliability often depends on the effect of one component of the fluid handling group on another during operational transients, either planned or of emergency nature. The solution is coordinated equipment



for power!

selection, engineering and design. And Worthington's "system" know-how and experience with modern complex plant cycles can help solve your fluid handling problems.

System-wise experience As the manufacturer of all major components of the Fluid Handling Group, Worthington has a reservoir of experience and knowledge that can be of benefit to you. To put this "system-wise" experience to work for you, get in touch with your nearest district office. Or write to section C-71, Worthington Corporation, Harrison, New Jersey.

WORTHINGTON

ALL IN A DAY'S WORK AT *Pittsburgh Piping*

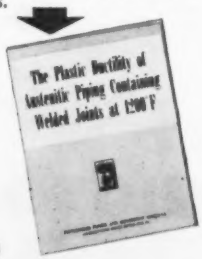
THE FIRST PIPING FOR ATOMIC POWER

Fabricated section in foreground is austenitic steel piping—the first fabricated for the world's first big atomic-power central station. Other components of this system are shown at the right.

This piping is a record maker—being the first ever made for a big atomic-power plant—the Duquesne Light Shippingport station. This job, while challenging, was facilitated by employing the techniques which we had previously developed for fabricating austenitic steel piping for central stations operating at steam temperatures of 1050°F. and higher, as well as for the *Nautilus*. In fact, Pittsburgh Piping was among the first to fabricate stainless steel piping—for the process industries, in 1927. And, we pioneered the use of stainless steel piping materials in the power field. We have the experience and the facilities—use them on your high temperature, high pressure piping jobs.

FREE TECHNICAL BULLETIN ON PIPING MATERIALS

This bulletin reports an intensive investigation into the problem of main steam piping materials and gives data on the stress rupture characteristics of Types 316 and 347 stainless steel piping adjacent to welded joints.



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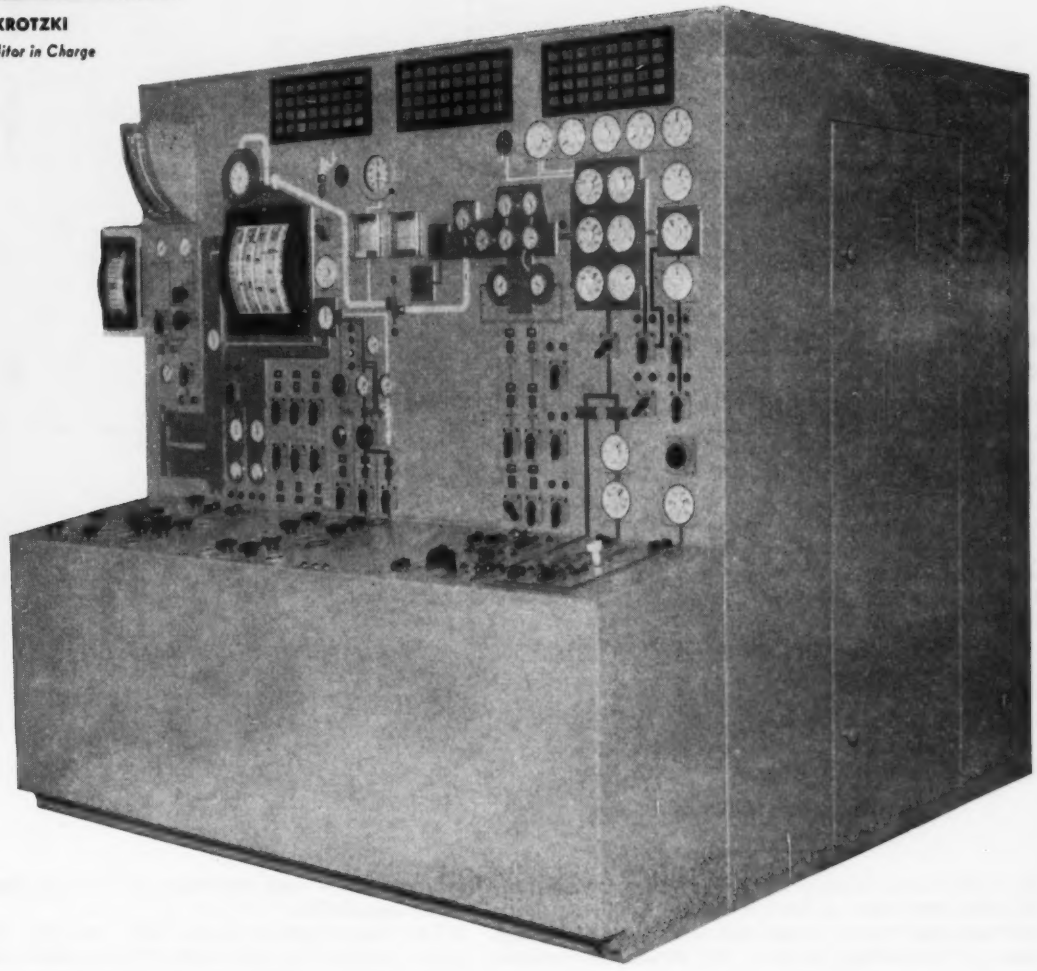
PP-33

B G A SKROTZKI
Associate Editor in Charge



B-T-G control panel: An unusual twist on . . .

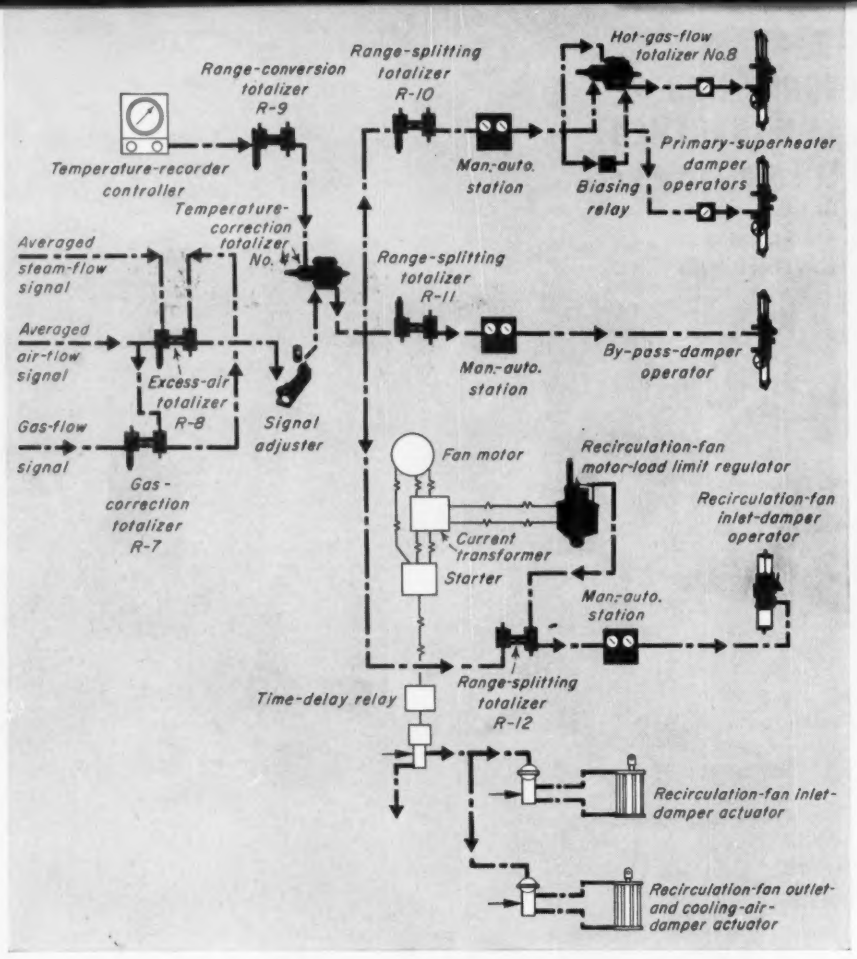
Today's controls practice

By J H WOODWARD, *Superintendent, Cecil Lynch Station*
and T HARRIS, *Superintendent, Harvey Couch Station, Arkansas Power & Light Co*

►THE BOILER-TURBINE-GENERATOR control panel, above, is the focal point of a recently installed system of automatic controls at the Cecil Lynch Station of the Arkansas Power & Light Co. Duplicate unit is the nerve center of AP&L's Harvey Couch Station. Each serves a 1,200,000-lb-per-hr boiler and 125,000-kw turbine-generator.

With control signals for an entire power-generating package flowing into a single panelboard featuring a schematic layout of the system, the operator can tell, at a glance, operating conditions at strategic points in the system. And he's in a position to do something about them.

What's the engineering thinking behind this system? What has AP&L's operating experience been? Following pages give a firsthand account.



Steam-temperature control system

Steam-temperature control is handled by regulating the positions of the superheater series dampers, superheater by-pass damper and gas-recirculation-fan dampers. If temperature falls below set point, superheater by-pass damper moves toward a closed position, forcing more hot gas over the superheater section.

To realize the advantages of installing large modern units of power generation, we gave the nod to a fully automatic and centralized control system that would yield (1) a high degree of measuring accuracy (2) precise and sensitive control (3) centralized operating info and control (4) greater safety as the result of reliable controls and interlocks and (5) eliminate high pressures in the control center.

Full scope of the system shapes up like this: Boiler-combustion, drum-level and steam-temperature controls operate in conjunction with automatic unit load control. Load control, based on system load and frequency, receives its impulse from the load-dispatching station about 120 miles from our most remote generating plant. Variations in generator output occur continuously. Instantaneous swings are limited to 3½% of full load, followed by 3%-per-min changes.

Steam generators for the 125-mw additions to Harvey Couch and Cecil Lynch Stations are 1,200,000-lb-per-hr, single-drum radiant units operating at 1575 psig, 1005 F. Furnaces are pressurized and units are designed to hold constant superheat temperature from 800,000 to 1,200,000 lb per hr. Temperature regulation is by flue-gas series and by-pass dampers and gas recirculation.

Three decks of six burners each are combination ring-gas and center-gun steam-atomizing oil type. We can manually light only the gas burners with a spark-ignited pilot flame. Feedwater, from a single line, divides at the drum for multiple-point feed. Steam to the turbine is also carried by multiple (twin) lines. We meter main steam flow with a nozzle in each line.

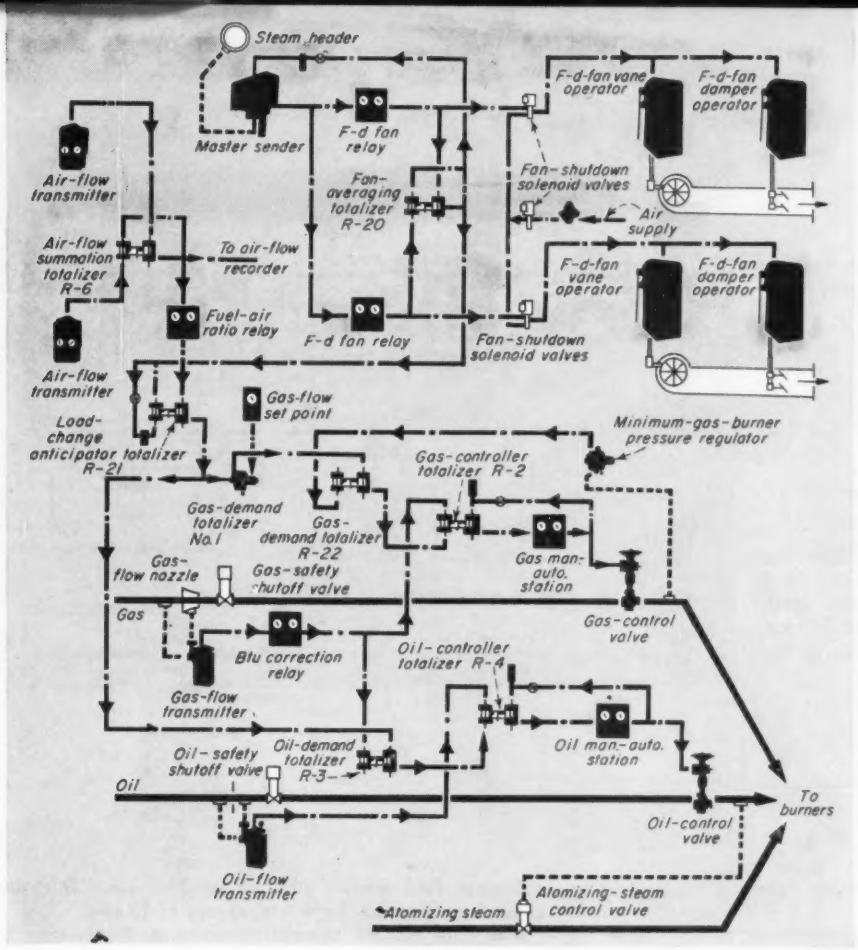
The control system automatically maintains (1) main steam pressure and temperature (2) boiler-drum water level (3) most economical combustion of natural gas and/or fuel oil.

Safety devices include automatic furnace-purge system and automatic fuel shutoff that operates when (1) we lose both f-d fans (2) fuel-gas-burner pressure drops too low (3) furnace pressure goes too high or (4) we lose atomizing steam. If only one f-d fan is lost, control automatically shuts the fan discharge and the inlet dampers.

STEAM TEMPERATURE CONTROL

Steam temperature control, as we've seen, depends on regulating positions of the superheater series dampers, superheater by-pass damper and gas-recirculation-fan dampers.

For top one-third of the load, on gas fuel, we maintain main steam temperature by operating the two series superheater dampers. If temperature tends to fall below the set point, superheater by-pass damper moves toward a closed position, forcing more hot gas over the superheater. On oil firing and low load with natural gas, we recirculate hot gas from the economizer outlet to the furnace with the gas-recirculation fan. Quantity recirculated is controlled by opening the fan-discharge and inlet dampers and positioning its inlet-control damper. We protect the fan from hot furnace gas by linking the outlet damper with the cold-air



Combustion control system

Taking air signals from a master sender, the combustion-control system picks up variations in main-steam pressure. This impulse establishes combustion-air flow. Fuel flow follows air flow and is set so excess air is kept to a safe minimum. All components are built for easy checking of system calibration.

inlet damper. Thus, when discharge damper is closed, the cold-air inlet damper is open. Cold air from the f-d-fan discharge duct then causes a positive pressure in the fan housing and ducts (with respect to the furnace).

By tracing out the drawing, facing page, we see a signal that represents average air flow, coming from the combustion control system to the R-7 totalizer. Here, the gas-flow signal is added in. Combined signal goes to the R-8 totalizer where it's compensated for under- or over-firing during load changes. Result is modified by the signal adjuster. The signal then enters the No. 4 temperature-correction totalizer where an impulse from the temperature recorder applies a correction. Next, the R-10, R-11 and R-12 totalizers split control range between the three sets of dampers. Biasing relay, connected to the superheater-damper control system, allows us to open one primary superheater damper and close the other to compensate for steam-temperature differences between two sides of the boiler. Thus, we can redistribute hot-gas flow from one primary superheater to the other, maintaining desired temperature in each header.

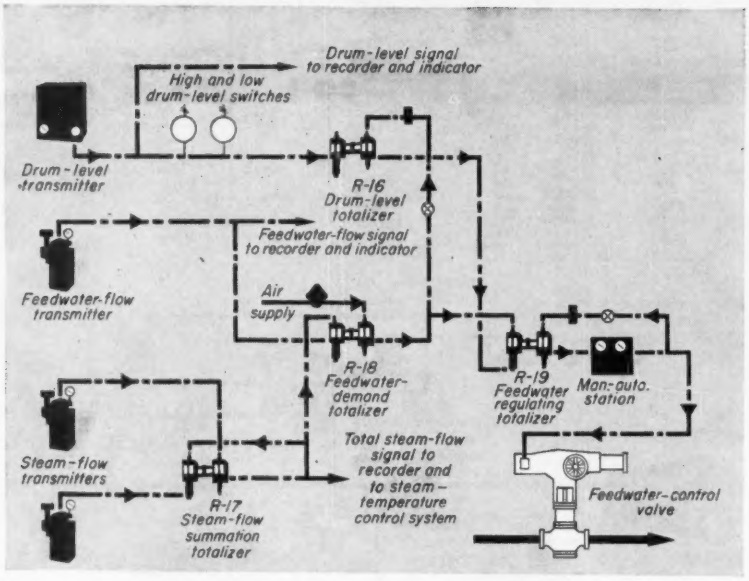
COMBUSTION CONTROL

The combustion control system, above, takes air signals from a master sender that picks up pressure variations in the main steam header. We use the output signal to position the f-d-fan inlet-vane and discharge dampers, thus establishing combustion-air flow. Air flow from the f-d fans through the air preheater, divides and is routed to the burner windbox through ducts on each side of the boiler. We measure air flow in each of these ducts and, by means of an air-flow transmitter, send pneumatic signals representing air flow, to the R-6 totalizer. Output of this totalizer is the fuel-demand signal.

Normally, the fuel-demand signal, acting through the gas-flow regulating system, controls natural-gas flow to the burners. But we modify this signal twice before it reaches the gas-controller totalizer, R-2. First, to maintain correct excess air, we establish the fuel-air ratio by means of a relay. Second, we apply an anticipating signal with a load-change anticipator totalizer, R-21. To reset the gas-controller totalizer, R-2, we measure fuel-gas flow and generate a pneumatic impulse from the gas-flow transmitter. Signal from the R-2 controller totalizer is modified by a Btu-correction relay, keeping pointers aligned on the boiler performance indicator.

When burning multiple fuels we measure gas flow. Amount by which the fuel-demand signal exceeds actual gas-flow indication signal represents fuel shortage. Then, by regulating fuel-oil flow to burners, we make up gas deficiency.

Built-in safety features include three shutdown solenoid valves, minimum-gas-pressure regulator and a gas safety shutoff valve. If one fan fails, fan-solenoid valve trips, closing the fan vanes, dampers. If both fans fail, all three solenoids trip, and all vanes and dampers go wide open. The minimum-gas pressure regulator acts to establish minimum gas flow if the unit is momentarily lost. And the low-



3-element feedwater regulating system

Typical of today's 3-element feedwater controls, the Harvey Couch and Cecil Lynch installations sense drum level, feedwater flow and steam flow, to send a composite pneumatic signal to the feedwater control valve.

gas pressure switch acts on low burner pressure to trip the gas shutoff valve.

All combustion-control components are constructed so we can easily make calibration checks. And once they're calibrated we maintain accuracy over long periods.

3-ELEMENT FEEDWATER CONTROL

The boiler-drum water-level control, above, is typical of today's 3-element systems. We feed steam to the turbine through two lines. Steam-flow transmitters on each line send impulses to a totalizer, R-17. Output from this totalizer goes to the feedwater-demand totalizer where it's balanced against a pneumatic signal from the feedwater-flow transmitter. From here, the signal takes parallel paths to opposite chambers of the feedwater-regulating totalizer, R-19. But first, one of the paths leads to a drum-level totalizer, R-16, which applies a correction if drum level is off its set point.

Any unbalance of pneumatic signals that go to the opposite chambers results in an output signal that restores the balance by regulating boiler feedwater flow.

OUR OPERATING EXPERIENCE

Charts, facing page, illustrate performance of the control system under actual operating conditions. The set shown is for the Couch Station for a single day (Sept 14, 1956). From top to bottom, we see records of unit loading, mw; steam temperature, F; steam flow, lb per hr; steam pressure, psi; natural-gas flow, cfh; air flow; feedwater pressure, psi; feedwater flow, lb per hr; drum level, in.; oxygen in flue gas, %.

We've selected the following times to indicate equipment performance: (1) on and off automatic load control (2) during normal load cycling (3 to 5% of rating) (3) during normal load changes (10% or more). The Couch system was on automatic load control from midnight to 2:45 am and from 10:15 am to midnight. Maximum load change on automatic load control occurred at 7:40 pm. This was about 4 mw per min, for a total change of 15 mw.

The unit was on automatic-combustion, steam-temperature and drum-level control all day. Note the lack of fluctuation in the steam-pressure line compared to jogs in unit loading or steam flow and air flow. Also, since fuel flow follows air flow, air flow changes are closely repeated in the fuel-gas flow line. Result: Fuel-air ratio stays in balance, maintaining efficient combustion. Excess oxygen record shows *how well* the ratio is kept in line. (Note: On the top row of circular charts we've purposely raised the steam pressure pen from its normal 1550 psi to about 2150 psi, to get it out of the range of the other lines.)

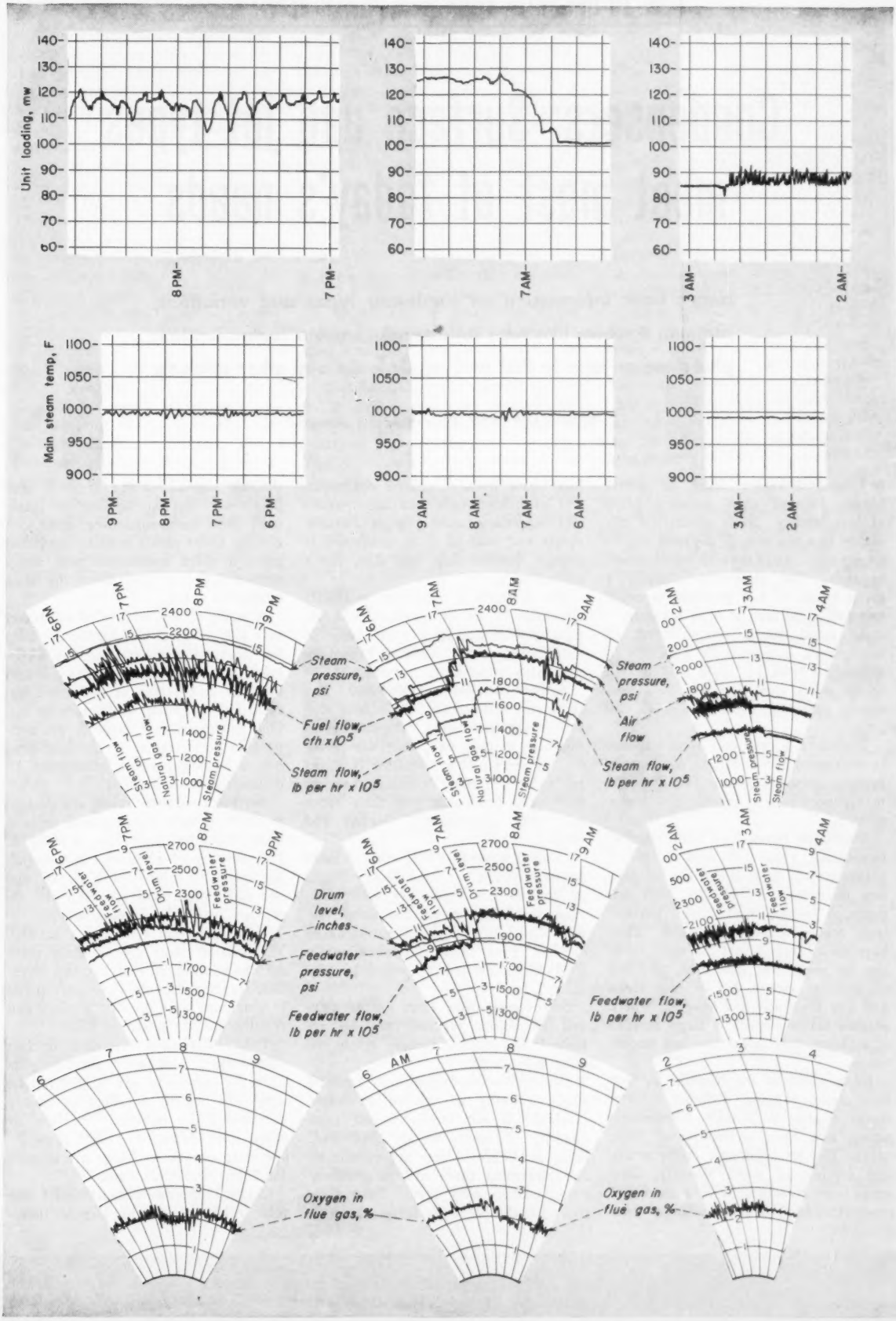
As we've already seen, with fluctuations in steam flow and combustion, flue-gas series and by-pass dampers must be repositioned to maintain constant steam superheat. The charts show a maximum steam-temperature variation of about 12 F during maximum load swing, and a spread of about 20 F during manual load change.

Since we put this control system in service, operating experience has shown us that the investment in a well-designed control system is money well spent. We've experienced erratic load-control operation, operation with only one fan in service and both partial and complete instantaneous load loss. Throughout these times, the controls functioned in accordance with their design specs.

In brief, we've realized operating cost savings as a result of (1) more economical boiler operation (2) reduced maintenance on auxiliary equipment, because of less variation from set points (3) fewer accidents to men and equipment because we eliminated high pressure in the control room, installed safety interlocks (4) more efficient and alert operators stemming from centralizing operating info, simplifying controls and eliminating routine tasks—manually regulating pressures, levels, etc.

Control system drawings on pp 80-82 were supplied through the courtesy of Hagan Chemicals & Controls, Inc.

A day in the life of AP&L's recently installed control system



HOW TO ORGANIZE YOUR NEW POWER PLANT—29

Condensers: Surface and jet types meet most of today's needs

Here's basic information on condenser types and variations, common troubles like tube failures, condensate contamination, plus dope on how to find and repair leaks and other ailments

By DONALD SWIFT, *Ebasco Services Incorporated*

► CONDENSERS are used in power plants because they improve plant cycle efficiency. Basic theoretical efficiency in a steam cycle depends largely on pressure range through which steam expands. But expansion through a given range at low pressure is much more effective than at high pressure.

At usual steam temperatures, as much work is potentially available in expanding from 14.7 psia to 1 in. Hg as by going from 150 psig to atmospheric pressure, or from 750 to 150 psig.

Therefore, a relatively large expense is warranted for installing condensers, pumps, circulating-water facilities, etc to expand steam as completely as possible.

Condenser types. Two basic types of condensing apparatus used in power plants are the surface and the jet. Surface condensers handle the great majority of turbine installations, particularly where makeup is small. They have the advantage that the same water can be used over and over, and the steam-water system can be kept clean and free from dirt and oxygen. Where process losses require a large amount of makeup, this factor has less importance.

Jet condensers are feasible for use with steam engines. Exhaust from a steam engine is usually oil-contaminated, and the condensate of little value. The jet condenser mixes steam and condensing water directly, then sends them to waste. With a good air-removal system, a jet condenser uses less water than a surface condenser, and probably needs less maintenance and operating care. Space requirements and cost of a jet condenser is usually considerably less than for a surface unit.

But a surface condenser normally maintains a better vacuum, and its pure condensate is a great help in conditioning boiler water in high-pressure high-temperature installations.

Surface-condenser variations. The form and arrangement of surface condensers varies widely. Depending on direction of tube axis, they are classified as horizontal or vertical. Horizontal units are more common because they save headroom and their tubes are more conveniently cleaned and packed.

Cooling water may make one or more passes through the tube bank. Single or double pass types are most common, the latter giving the same vacuum with less condensing water. Three or four pass types are occasionally used where condensing water is very limited.

Steam may enter from top or side, and condenser surface may be arranged in single, double, triple or quadruple shells.

Evaporative condensers may be used where quantity of condensing water available is not much greater than quantity of steam to be condensed. Here, air is blown over the outside of the condensing tubes and, in addition, water trickles over them. Thus they approach the wet-bulb temperature of the air instead of the dry-bulb temperature. This application is rarely used for steam-condenser work. A cooling tower plus a regular condenser gives a more economical and better performing unit, uses about the same amount of water.

A straight, dry, air-cooled condenser may also be used, eliminating the need for condensing water. But the air-to-metal heat transfer rate is much poorer than steam-to-metal or water-to-metal rate. Hence, either the condenser surface has to be very large to get comparable performance, or the heat head has to be large, with a consequent deterioration of performance.

Surface condenser tubes are straight to facilitate tube cleaning and replacement. Lengths range from 6 to 30 ft. Excessive length requires a corresponding space for tube removal on at least one end of the condenser and also increases required pumping head.

Tube diameters are ⅝ to 1 in. OD. The smaller sizes give slightly more surface per weight of metal, and better heat transfer. But they are more liable to plugging, more difficult to clean and require greater pumping head.

Tube thicknesses are more or less standardized, with two or three weights normally available for a given tube size. The weight specified is mainly determined by erosion, vibration or other wear expected, rather than by operating pressures. These are usually far below the stress limit.

Condensing water characteristics and tube velocities should largely deter-

mine the type of alloy used in a given condenser. Certain materials give good wear at minimum cost for a given type of water. List below shows generally used alloys, with water conditions for which they are suitable. Note that as resistance to corrosion increases, resistance to heat transfer also increases.

Arsenical Copper: Occasionally used with cooling towers using fresh water with low water velocities in the Southwest; heat transfer coefficient 1.00.

Admiralty metal: Used with sea water, fresh water, cooling towers; keep velocities below 7 fps with sea water; coefficient 1.00.

Aluminum brass: Used with sea water, higher water velocities; coefficient .96.

Cupro-nickel 90-10: Used with sea water, polluted fresh water, high water velocities; coefficient .90.

Cupro-nickel 70-30: Used with sea water for most severe corrosion and velocity conditions; coefficient, .83.

Different manufacturers add small percentages of phosphorous, arsenic or antimony in an effort to further improve the qualities of copper, admiralty and aluminum brass tubes. Manufacturing methods, evenness of mixing of the alloy elements, methods of forming and finishing the tubes also affect tube life and performance. Condenser tubes are usually inspected individually before installation, to insure against defects and cracks.

In most installations condenser tubes are rolled into tube sheeets on both ends. The inlet end is belled to reduce entering water turbulence, while the outlet end is cut off, perhaps ¼ in. outside of the tube sheet. With both ends fixed, expansion must be taken care of by (1) allowing the tubes to bow slightly or (2) providing an expansion joint for one or both of the tube sheets. If one end is packed while the other is rolled, this provides for the necessary tube expansion. In some condensers, both tube ends are packed. Condensers for supercritical pressure plants will probably have the tubes welded to the tube sheets at both ends to reduce leakage.

Tube packing. There are numerous variations of condenser tube packing. The original packing was probably corset-lacing wound around the tube and held in the packing recess of the tube sheet by a ferrule. Various other fibrous materials and metals have been used.

One of the more successful packings uses alternate rings of lead alloy and fiber, expanded to engage the threaded sides of the ferrule hole. The fiber expands when wet to give a tight seal. If a packed condenser stands dry for a day or two, the packing may dry out and allow severe leakage with resultant condensate contamination.

Tube failure may have several causes. In a new unit vibration fatigue is most frequent. If the tube is supported at points more than about four feet apart, vibration failures are likely to occur as the tubes are not stiff enough to withstand the buffeting of the high velocity exhaust steam. These failures almost always occur in the two or three rows of tubes that first feel the force of the entering steam.

A lattice work of thin wood strips wedged between the top few rows of tubes usually stops this vibration. A more permanent but much more complicated and expensive remedy is installing additional tube support plates. This is sometimes done when an entire condenser needs retubing.

Fatigue cracks usually occur at or near tube sheets or support plates. One tube usually fails at a time. Cracks are best plugged with a tapered piece of soft wood, such as pine.

When a number of tubes have been plugged, they may be replaced at some convenient time. A few plugged tubes in a good-sized condenser do not ordinarily cause any noticeable effect on condensing-water flow or condenser vacuum.

In older units, tube failure frequently results from external erosion. This may come from (1) excessive water concentrations in the exhaust steam or (2) some condensate return line or steam line drain that allows a high-velocity water jet to strike the tubes. Low superheat in steam to the turbine may cause excessive moisture. You may be able to increase the superheat without getting into other troubles.

If water concentrates in one zone, install deflectors to keep it away from the tubes. Sometimes a screen of subway-grating steel installed at the condenser steam inlet will break the force of the water-steam flow. The best correction for erosion from this source, is to weld a deflector or diffuser on the inside of the condenser, over return or drain line entrances. It should keep water from striking the tubes at a direct angle.

If there is a lot of hot water, spray it over a considerable tube area to cool it and avoid steam blanketing the air pump offtake line. The recirculating lines from condensate, steam-jet air pump or boiler feed pumps are especially important. Carefully inspect a new condenser before putting it in operation. See that all entering lines are properly baffled to prevent tube injury.

Another type of erosion may occur inside the tubes from action of the condensing water. If water carries much sand, tubes become polished, then worn, especially near inlets where water is more turbulent. Erosion is much more rapid if velocity is high. If condenser water boxes are shallow or water enters them at high speed, the difficulty is accentuated.

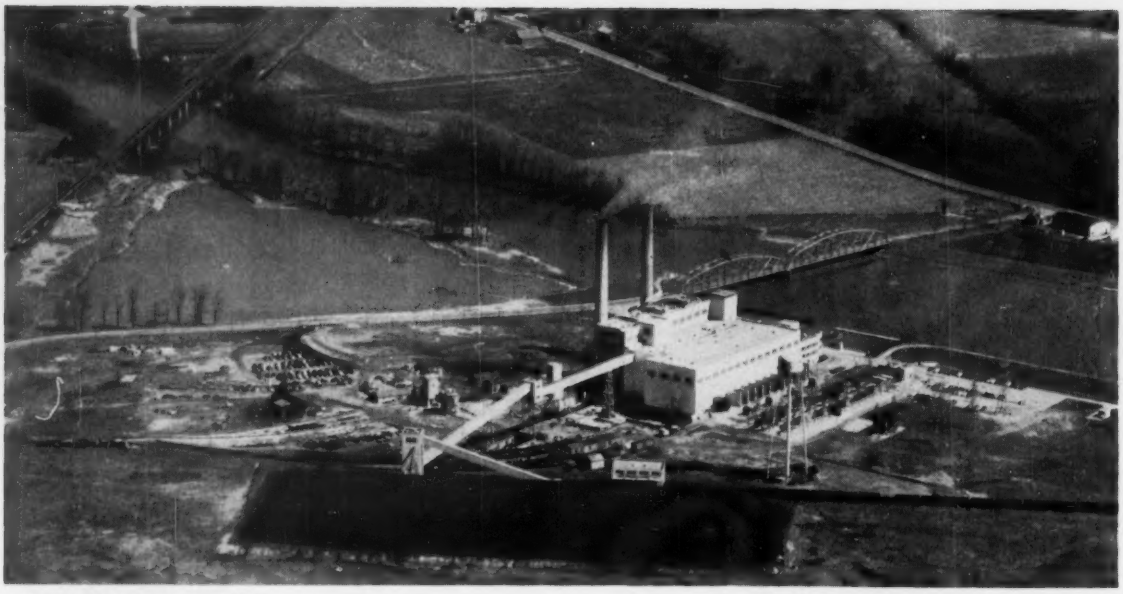
If the condenser is set well above the water discharge level, so it operates under a vacuum, water tends to release any air absorbed in it. Air bubbles escape at points of eddying and quick directional change. The air release often causes wear and roughtening for a few inches near the tube inlets. With high water velocities the entire tube may be worn. Best practice limits water velocity to 7 to 8 ft per second; higher speeds may cause accelerated tube wear.

Belling the tube inlets and avoiding eddies and high-velocity water entrance points are helpful. Sleeves made of tube material or of plastic are sometimes used inside worn tubes to extend their life. They have a gradual slope and a belled entrance. Another tube-saving expedient employs a coating of cement base or plastic paint for a few inches at the inlet end. Still another method, satisfactory only if the tube metal is in good condition, is to cut off the worn end and stretch the tube the necessary few inches, then re-expand and bell.

The other main cause for tube failure, dezincification, occurs only in alloys made with zinc. Electrolytic cell action removes zinc from the metal. The remaining metal is porous or brittle. Leaks or tube breakage occur soon after the zinc has been lost. Apparently a nonuniform alloy in the original tube metal forms cells of varying composition and electric potential. When the water passing the tube is highly conductive, a battery action wastes away the less noble portions of the tube.

A similar corrosive condition sometimes occurs when a condenser stands idle with dirty or concentrated water in the tubes. If a condenser with rolled tubes is to stand idle for a long time, tubes should be cleaned with rubber plugs and flushed with clean fresh water. If tubes are packed, the pack-

(*Continued on page* 192)



FIXED CONTOUR coal storage pile may simplify inventory volume measurement, but doesn't serve its optimum purpose

Erase a chronic ailment:

Use a mobile coal storage pile

By **FRED M REITER**, *Fuel Engineer, Dayton, Ohio*

► IN 1955, a succession of adverse events caught a great many industrial and utility plants with their coal piles down. The situation—one that could easily repeat itself in the future—made these plants pay heavily for not being prepared. If the same situation developed within the next six months, many of today's plants would be caught again. Conditions that would permit this to happen aren't at all necessary. Let's see why this is so.

Prior to 1955 my company, a large Midwest utility, held coal in "dead" storage in the same manner as most large coal-burning plants. Our four storage piles were formed into fixed trapezohedral patterns, photo, above, to simplify our annual inventory volume measurements. We avoided any alterations in the form so contour lines would remain fixed year after year. We went to great lengths to keep our bunker coal coming in uniformly day by day. Daily instructions went to coal shippers, railroad dispatchers and others concerned, in order to avoid disturbing these well-shaped storage piles. One pile wasn't touched for many years. The steam crane intended for moving the coal was fired up and run back and forth once a year as a maintenance procedure.

Maintaining the fixed storage piles developed into a Herculean task. We received coal from more than 50 suppliers located on six different origin railroads. These funneled the coal to a single railroad that feeds our power stations. Unloading to storage was a frequent threat to avoid demurrage charges when bunched cars piled up debits on our averaging agreement. Extra costs of handling the coal in and out of storage and tie-up of manpower and equipment added to the incentive to keep the pile undisturbed. Also, we believed, keeping the coal pile intact reduced the rate of weathering.

The year 1955 put an end to aesthetics. A railroad strike deeply dented the pile at our Southern plant. Despite increased coal tonnage delivered via the Ohio River and by truck, the pile's contour lines shifted constantly. Our coal piles began to take on the function of their basic intent, such as a receiver in a compressed-air system, or the standpipe in a water system. They became tons of available coal that substituted for the failure of our daily supply.

Then came the augmented demands for coal by other users. This resulted in a steady stream of coal to outlets where prices were best. Undoubtedly a great many coal piles shrank simultaneously with ours.

Factors that boomed the coal industry quite suddenly were many and varied. Some of these were:

The 2-month strike of a major Midwestern railroad removed considerable production tonnage from the market and depleted reserves of those using this railroad's origin coal. Shifting of coals from other operating railroad areas to markets of the striking railroad's origin mines spread the shortage into broader fields of consumption. An almost universal depletion in the

1: Stocks of bituminous coal and lignite on hand

Coal consuming industry	June, 1955	April, 1955	July, 1954	% change From July, 1954 to April, 1955	% change From April, 1955, to June, 1955
	Thousands of net tons				
Electric power utilities	39,225	37,376	38,848	+4.95	–4.94
Coke ovens	12,747	10,702	11,125	+19.08	–3.95
Steel and rolling mills	548	534	639	+2.62	–19.66
Cement mills	1,140	970	1,123	+23.68	–15.77
Other industrials	13,258	12,469	12,889	+5.95	–3.37
Railroads, Class I, A.A.R.	1,120	1,219	1,662	–8.12	–44.46
Retail dealers	1,197	731	900	+34.73	–23.12
	Days of supply				
Electric power utilities	104	113	132	–7.97	–16.81
Coke ovens	44	38	52	+13.64	–36.84
Steel and rolling mills	50	38	63	+31.58	–65.79
Cement mills	51	43	52	+18.60	–20.93
Other industrials	63	50	83	+26.00	–66.00
Railroads, Class I, A.A.R.	30	30	40	0	–33.33
Retail dealers	16	8	13	+100	–62.50

2: Days of supply for two important users

	August, 1955	August, 1954	Change from 1954, %
A. *Electric power utilities:*			
New England states	83	128	–35.16
Middle Atlantic states	84	112	–25.00
Ohio	119	144	–17.36
Michigan	151	98	+54.08
Indiana-Illinois	144	126	+14.29
Lower Missouri states	207	195	+6.15
Southeast United States	118	86	+37.21
Southwest United States	223	205	+8.78
B. *Cement mills:*			
New England states	41	40	+2.50
Middle Atlantic states	27	32	–15.63
Ohio	79	44	+79.55
Indiana-Illinois	43	45	–4.44
Lower Missouri states	112	237	–47.26
Southeast United States	34	39	–12.82
Southwest United States	40	59	–32.20

Eastern areas was practically inevitable.

Demand for electric power jumped abnormally, especially during the hot-weather air-conditioning demand. This pushed daily coal use estimates above expected procurement requirements.

The anticipated rollback of the 35c-per-ton rail rate reduction to the Great Lakes moved record tonnages to the Lake ports in order to beat the rise in destination coal costs to Northern and Lake consumers.

Tidewater demands at high prices diverted a lot of coal from normal industrial and utility markets to ocean ports.

Abnormal movement of coal cars to the Great Lakes and to tidewater depleted the car supply to regular consumers. Because of this lack of cars, our supplying mines lost many days of operation.

Predicted rise in coal wages, following those of the automotive and steel industries, prompted smart buyers to lay in plenty of coal even at somewhat higher than current prices.

Strikes threatened on two other major coal-moving railroads. This, close on the heels of the other strike, rendered large coal consumers allergic to any more possible stoppages of coal movement.

Examination of these factors, all occurring within a 6-month period, proves that coal piles are truly subjects for studies in economics. All of the factors were common knowledge to the careful observer and reader of periodicals reporting coal situations and trends. But many coal buyers haven't time to read all the necessary literature. Lucky are those who have alert associations that meet for earnest discussion of fuel problems. The fact that a 1c change in the cost per-million-Btu means about $250,000 to the consumer of one million tons of coal, lends emphasis to the need for consideration of coal-pile mobility.

The early part of 1955, we can say with good hindsight, was the time to increase coal-storage tonnage. Supplies were ample, buyers were sought. Experienced purchasers who bought coal during this period not only helped their own stockholders, but helped the coal and transportation industries.

Table 1 is an extract of the U.S. Bureau of Mines' Mineral Industry Survey of July 1, 1955 showing coal stocks on hand and days of supply in storage for three significant periods. The tabulation illustrates the shrinkage in coal stocks for about a year and the rather sudden upsurge within two months of 1955.

Table 2 shows days of supply for

3: Use tops estimated needs as power demand grows steadily

Month	Stockpile 1st of month	Estimated requirements	Procurement receipts	Actual coal consumption	Change in stockpile
September, 1954	220,980	61,000	68,343	65,254	+3,089
October	224,069	62,000	65,789	66,182	+393
November	223,677	58,000	62,625	64,004	–1,379
December	222,298	56,000	69,172	70,551	–1,379
January, 1955	220,919	64,000	70,511	72,870	–2,359
February	218,560	62,000	72,283	67,704	+4,579
March	223,139	68,000	54,302	73,300	–18,998
April	204,141	68,000	57,024	68,990	–11,966
May	192,175	65,000	75,361	73,000	+2,361
June	194,537	70,000	65,092	71,370	–6,378
July	188,259	70,000	68,728	73,500	–4,772
August	183,487	72,000	74,460	78,889	–4,429

4: Coal use in major industries shows gain

Coal consuming industy	May, 1955 1000 tons	May, 1954 1000 tons	Increase, %
Electric power utilities	11,439	9,133	+25.5
Byproduct coke ovens	8,621	6,581	+31.1
Beehive coke ovens	221	45	+391.1
Steel and rolling mills	341	315	+8.3
Cement mills	707	675	+4.7
Other industrials	6,508	4,809	+35.3
Railroads, Class I, A.A.R.	1,154	1,278	–9.3
Retail dealers	2,358	2,101	+12.2
Foreign ship bunker fuel	40	55	–27.3

two specific industries, in various parts of the country, and indicates the change between Aug 1954 and Aug 1955. It's interesting to compare the changes, perhaps in terms of "alertness" of the procurement agencies of the two industries, in different areas. Both industries are sensitive to direct public consumption. Paradoxically, the electric utilities' stockpiles increased, yet their days of supply dropped off —indicative of the increase in power-generating capacity.

One could visualize that areas distant from coal sources would carry large stocks for security against failures of supply. States having coal sources within their own boundaries would hardly be expected to show large stocks, with supply available nearby and with minimum transportation problems. These areas could save interest on investments in coal tonnages, property taxes, deterioration in heat values, less risk of fire losses, etc, by carrying minimum stocks. Yet Tables 1 and 2 portray no consistency among whole industries. Ohio, for example, shows a high reserve for electric-power utilities in 1954, with a relatively low stockpile for the cement mills. In 1955, the situation was reversed. Electric utilities storage dropped 17.3% while cement mills augmented their reserves 79.55%. Both industries reflect direct public demands of their commodities and form a good yardstick for gaging public needs. Other regions show similar diversity of thought or judgment in storage volume maintained during a period in which some drastic changes in demand, supply and prices could be anticipated.

Diversion of cars and locomotives to other delivery points caused our storage piles to shrink and expand from month to month as cars either bunched heavily or failed to reach us at all. The railroads did all they could to protect us by voluntarily placing periodic embargoes on coal-car movement to ports and putting the cars back on the lines to consumers such as ourselves.

It's obvious that unless storage recuperation is essential, a period such as this wouldn't be ideal for stockpile purchasing except as protection against supply conditions becoming worse. Consumers either had to pass up buying for storage during this period of boom deliveries to ports, or had to be willing to pay premiums or work much harder to get the extra coal. In our case, we used a fleet of trucks from Ohio River barges to back up the supply in transit from the mines to our stations. The trucks helped to level off fluctuations in amount of coal coming in daily by rail and augmented our bunker or storage coal as needed.

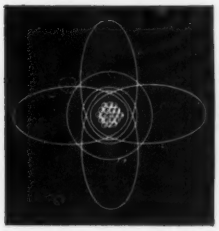
The biggest single factor that affected storage tonnage as well as purchasing for stockpiling was the continuously mounting level of coal consumption for power production—a situation that remains relatively unchanged today.

Table 3 illustrates the steady acceleration of power production for the 12-month period from June 1954. Requirement estimates for coal procurement, based upon curves and planning devices, lagged considerably all the way. Fortunately, our procurement "logistics" kept stocks from becoming dangerously low. Our "logistics" involved nothing more than keeping a weather-eye on the "pipeline"—coal flow—and maintaining a 5-day supply constantly in transit to us. This is where the aforementioned truck fleet came into the picture.

Table 4 shows coal consumption increases for the year 1954-1955 for representative major industries. With the exception of railroad usage, the average industrial increase totaled more than 25%. These almost universal increases affected stockpile profiles in several ways. Lags in their individual procurement systems dented them. The cumulative effect of the overall demand aggravated all of the problems assertedly due to Great Lake and tidewater diversions.

The resulting situation effectively speaks for itself in pointing up the need for timing purchases for storage when consumption trends are down-

(*Continued on page* 182)



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Argonne Boiling Water Reactor (ARBOR) will be designed by United Engineers & Constructors for erection by Argonne National Laboratory at the AEC's National Reactor Testing Station in Idaho. The reactor will generate 200 mw of heat at pressures up to 2000 psig. Schedule calls for design completion by May 1958 and awards of construction contracts by July 1958.

Carolina-Virginia Group has proposed to the AEC to build a heavy-water moderated and cooled reactor fueled with slightly enriched uranium. Plant will generate net electric output of about 17 mw. Proposal asks AEC to pay major part of development costs and waive charges for fuel and heavy water during contract period. Carolinas Virginia Nuclear Power Associates, Inc include: South Carolina Electric and Gas Co, Carolina Power and Light Co, Virginia Electric and Power Co and Duke Power Co. CVNPA has engaged: Stone & Webster Engrg Corp as architect-engineer, Westinghouse Electric Corp as equipment developer and manufacturer, General Nuclear Engineering Corp as consultant. This is third proposal received by AEC in response to its third invitation under the Power Demonstration Reactor Program.

Temporary regulation issued by AEC gives effect to indemnity legislation signed by President Eisenhower on Sept 2, 1957. The regulation gives immediate protection to the public, AEC licensees and their suppliers against losses caused by reactor accidents, while a permanent regulation is prepared. The AEC indemnifies each licensee and his suppliers up to $500 million for each reactor accident against claims arising from nuclear accidents that exceed the private insurance coverage carried by the licensee. Licensee must carry $150,000 per mw of thermal capacity, but not less than a total of $250,000. Reactors of 100 mw and larger must carry, in addition, the largest amount of private insurance protection available. Private insurance industry estimates this as $60 million. Premium payments by licensees to AEC will be $30 per mw of thermal capacity per year but no less than $100 annually.

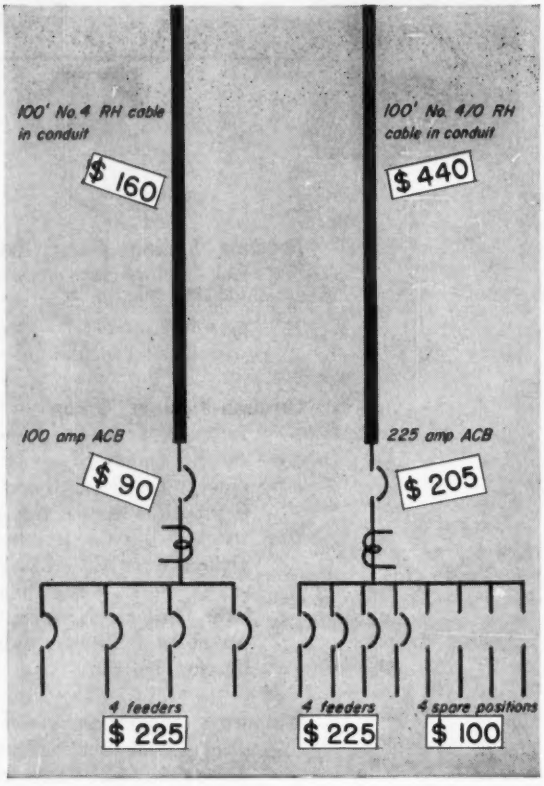
Congressional action sponsored by the Joint Committee on Atomic Energy of the U.S. Congress directs the AEC to invite proposals from private industry to develop a natural-uranium gas-cooled graphite-moderated reactor. This reactor is to power a plant to produce 40 mw net electrical output. September 23 had been set as the closing date for receiving proposals. AEC must report back to the Joint Committee on April 1, 1958 with a design, cost estimate and construction schedule.

Oak Ridge National Laboratory has shipped its 100,000th package of radioisotopes since August 2, 1946. It consisted of 75 millicuries of potassium-42, had a shipping weight of 16 lb, was sent to the University of Iowa for medical research use. Shipment No. 99,999 consisted of 1007 curies of cobalt-60, was sent to France in a shielded container weighing over 1½ tons. More than 4000 organizations have been licensed to use radioactive isotopes. Many others have received small quantities under general license.

Correction —July 1957 we reported that the Army Package Power Reactor had a foundation three times heavier than needed because of weight of hydrostatic-test water. This seemed to be the case in preliminary design layouts—but subsequent development increased other weights such as shielding and structure, so foundation strength actually was dictated by total equipment weight and not test water.

By **D L BEEMAN**, *Manager*
Industrial Power Systems Engineering
General Electric Co

A 600-times increase in small-plant electrical distribution capacity could possibly be handled when planned beforehand. All the steps, right from outgrowing 240 and stepping into 480 . . . from splitting busways as new unit subs come in, to building a true secondary selective scheme, hinges on . . .



TOMORROW'S LOADS can be handled in smaller plants with setup *right*. Note what you pay for more than double capacity

Planned growth stages: Key factor

► GROWING FROM A SMALL- to a medium-sized plant all too often means scrapping installed electrical gear simply because little or no power-to-grow planning was done during the early design stage. This waste of money and manpower can be avoided. And here's how:

Let's start out with a 50-kva plant and make a step-by-step examination of modern methods that could well be used in growing from 50 to 30,000 kva, a 600-times increase.

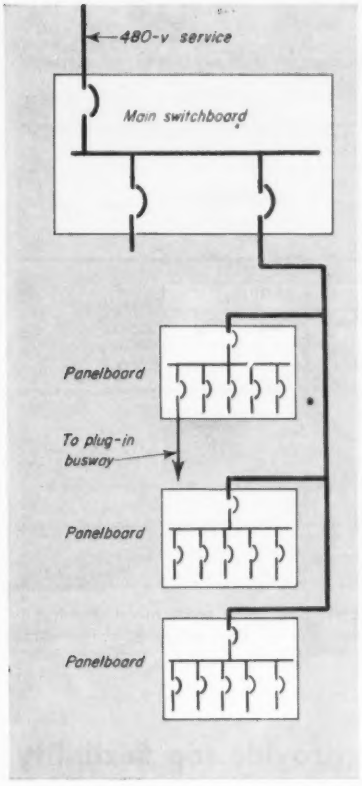
First step. The 50-kva plant would probably be served secondary power by the supplying utility. While it makes little difference in power cost whether this plant is served at 240 or 480 volts, any foresight indicates 480 as the most economical secondary voltage. So your first step is to pin-down the most economical secondary voltage for future growth.

Where only 240 volts is available, make plans for swinging over to 480 in the future. Do this by buying motors and other load equipment for 240 volts that can be reconnected for the higher voltage. All switches and circuit breakers should be suitable for 480 volts. True, some of these items may cost a little more now, but they permit growth at the higher secondary voltage without scrapping any equipment. It boils down to simply installing all equipment on the 240-volt system so it can be readily reconnected for 480 volts.

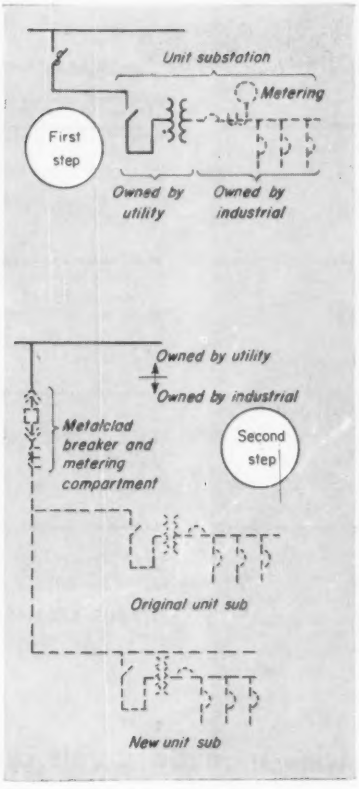
Second step. Once the secondary voltage level question is taken care of, the next move is to allow for some short-term load growth in the service entrance cable and main protective device. It's basic that capacity of these devices determines how much load can be used in the plant. To make these items twice as large as immediately required costs about $400 more than that needed to supply the bare minimums. Considering an overall plant investment of $100,000, this increase comes to 0.4%.

As plant grows, more secondary feeders will probably be needed, so provide space in the switchboard for additional secondary feeder protective devices. If these devices are the plug-in or drawout type, new feeder cables may be added safely without plant shutdown. Plug-in or drawout protective devices are a fundamental ingredient to easy growth.

Looking ahead in this small plant shows us three things up to this point: (1) Select proper secondary voltage or



TYPICAL LAYOUT after changing over from 208 or 240-v to a 480-v scheme



NEXT STAGE in growing up electrically calls for running high-voltage to subs

Power-to-grow!

The fundamental thinking behind this article is in line with the basic philosophy of the current Power to Grow . . . *electrically* program. This editorial feature started in POWER with the September 1956 issue.

The PTG program was initiated because of the marked lack in long-range planning in many industrial areas. So to pinpoint the need for *power to grow*, POWER has been running a series of articles covering various aspects of the industrial electrical system. To aid in measuring a plant's ability to expand electrically, the term PTG index was coined. By labeling installed electrical capacity as unity, the PTG index gives some measure of a plant's expansibility.

We define the power-to-grow area as the planned-for capacity that can be economically provided and later integrated into an existing system as need arises. Then, planned power-to-grow capacity divided by installed capacity is what we call the PTG index. It should serve as a practical guide for system planners. The PTG index may be two, three or more. The precise value is something you must decide based on the specific industry and growth potential.

in small-plant electrical design

arrange for easy changeover to it. (2) Allow for some short-term load growth by making the supply circuit somewhat larger than minimum required. (3) Use readily removable protective devices while providing extra spaces for future feeder additions so they can be made safely without shutdown.

This entire system may be but one small part of the future larger system. As the system grows there will be new capacity requiring more panelboards or switchboards to supply added loads.

Third step. The next step involves supplying several of the loads from a central point. This means adding a load center switching station to serve load areas. Keep in mind that the original 50-kva plant system is still fully utilized; no capital has been wasted. There are just more small systems being fed from one central switchboard.

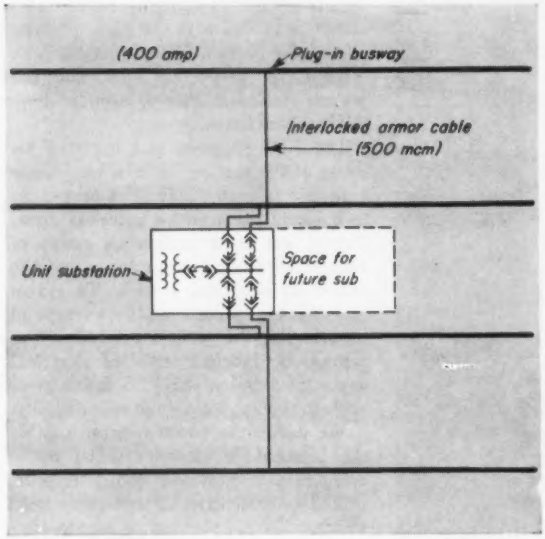
This is still a secondary distribution system so no new problems are encountered in voltage selection. New switchboard should have a few extra positions for drawout or plug-in protective devices, so extra circuits may be added. The main device (breaker or fused interrupter switch) in the central switchboard should have added capacity for growth.

Actually, no new principles are included in this expansion period. However, two factors should now be brought into the picture.

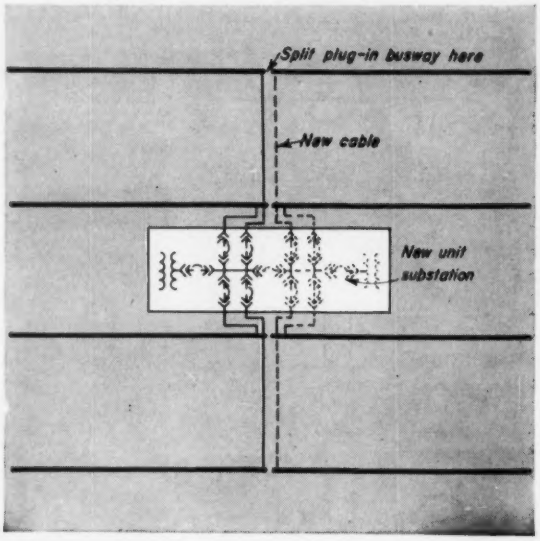
First, the central switchboard is like the secondary switching section of a load-center substation. So we should be thinking ahead to a load-center power-distribution system as the next step. This means determining substation size, plus conversion to buying primary power.

For top economy, 480-volt secondary subs should be in the 500- to 1500-kva range. So size this new switching center for about 500-kva minimum. That means an 800-amp main breaker with feeder circuit breakers boasting at least 15,000-amp interrupting rating.

Second, plan for a load-center substation transformer with this central switchboard. Quite often the power company will install a separate transformer for this plant when load reaches 150 to 500 kva. That being the case, the arrangement might wind up with the utility owning the transformer. But look ahead to when you want more than one transformer. Then you will probably select to own the



PROVIDING SPACE for future distribution gear is generally a toughie to sell in the planning stage—but it pays off



SPLIT-BUS ARRANGEMENT, new cable feeds mean double capacity once second unit sub is tied in with the original

Plug-in busways teamed with secondary unit subs provide top flexibility

transformer, the primary feeder and the primary protective device.

Load-center step. When you reach the point of owning the transformer, you are really on the threshold of starting a load-center power-distribution system. Let's stop now to see how the load-center system can meet growth needs without throwing away, but merely adding on to what is already there.

A load-center system can grow almost indefinitely, from one load-center unit sub to 100 or more. Merely extending the primary feeder and adding more load-center substations means the system can be expanded to serve additional unit load areas. There is, of course, a limit to the number of substations that can be placed on one feeder. When one primary feeder is not big enough then the second primary feeder is added and the process continued. Through the proper selection of primary voltage this system can supply plants of several hundred thousand kva; the largest now in existence or the largest in the foreseeable future. With this building block or modular approach all you do when you expand a system is add more building blocks or modulus. Ultimate expansion is limited only by the number of building blocks you can get in a given area.

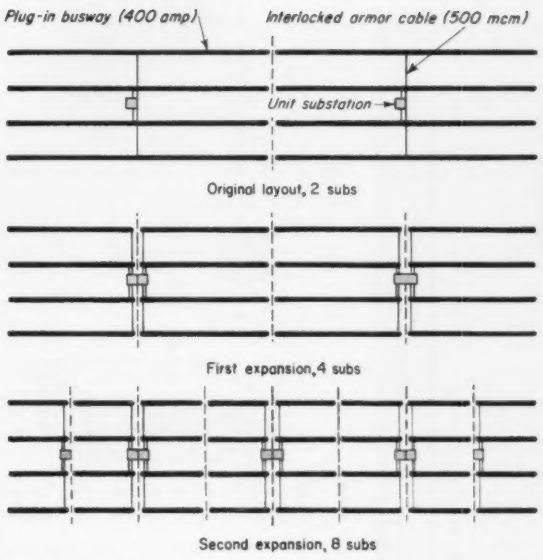
Load-center systems in use today serve industrial plants with load densities up to 100-volt-amp per sq ft of floor area. The load-center system has been applied to these plants as easily and economically as it has to plants having load densities only 5 volt-amp per sq ft. In looking ahead to foreseeable practical load densities per sq ft, there seems to be no stumbling blocks to adopting the load-center power-distribution system.

Illustration just described applies when there is an increase in factory floor area. Same approach can be used when the power increases in a given building without expanding floor area, if the proper preplanning is done. Following describes how, by proper planning, you can double, triple or quadruple the kva capacity in a given building:

The split busway. There may be only one substation per unit area. Interlocked armor cable secondary feeders run out connecting to plug-in busway. If enough space is provided at each existing substation location to add another substation, then area capacity can be doubled by simply adding the new load-center substation, new secondary feeder cables, and sectionalizing the plug-in busway, see sketches. Busway runs are now only half as long. There has been no change in the busway system, except sectionalizing, or in any load connected to it. There is merely the addition of another primary feeder, load-center unit substation, and secondary feeders out to new tap points on the busway. Busways are readily separated by unbolting the joints.

And split again. Additional substations could be dropped in between pairs of double-ended substations and busway further divided to quadruple system load capacity. Note, there has been no change in the busway system except to sectionalize it. Utilization and production equipment are not affected.

What circuitry? Now look at circuit arrangements and primary switchgear setup. Probably the primary feeders



SAME BUSWAY can be split further, fed from several sources as load grows. But sub space must be set in original plans

geared for simple low-cost growth

will be radial and so will the load-center system circuit arrangement, at first. Hence, we need only one primary circuit breaker and feeder. But as load grows, more unit substations are added to this feeder, see sketches. When the one feeder becomes fully loaded, a second feeder is added and more unit subs are brought in.

If your look ahead indicates a secondary selective load system, keep the following thought in mind: Before buying the first primary feeder circuit breaker, plan ahead to be sure all equipment purchased can be used in the future, and additions made with a minimum downtime and change of what is already installed.

Many small plants are served at below 15 kv when primary service is purchased. But, whatever the voltage, consider using the largest interrupting-rating primary circuit breakers. Example: Suppose this plant were served at 4.16 kv, then select 250-mva 4.16-kv switchgear.

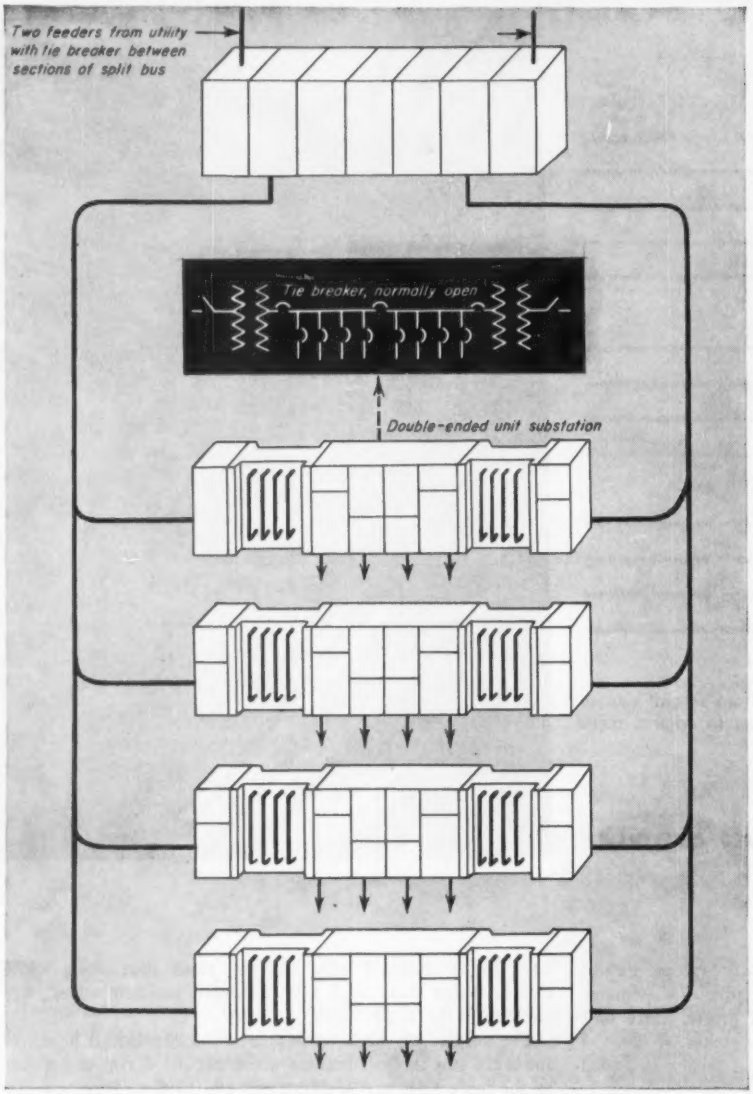
Looking ahead we may say that the system shown, p 94, is the ultimate for expansion of this plant. It embodies the proven concepts of modern system design for a plant with up to about 10 to 30-mva load. Now let's follow each step in building up to this ultimate secondary selective scheme.

First primary system need include only one-half the first unit substation, primary-feeder switchgear, metering facilities. Another way of approaching this first stage for lowest first cost is to install the main breaker now, but use it as a feeder circuit breaker. Then the feeder cable connects directly to this breaker. However, the cable connection will have to be changed later and the plant shut down while this is being done and a true feeder position added, see sketches 1 to 7, pp 94-95.

For only a very little more money you can install housings for main and feeder breakers while putting a feeder breaker in the main spot and a dummy in the feeder. Now, no further changes are required which necessitate shutting down the plant. To carry this one step further, the tie-breaker housing could be installed now and then all growth would take place without shutting down the entire system.

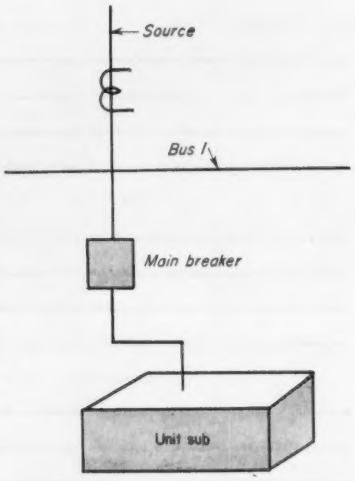
As plant grows, other end of the first unit substation may be added to make it double-ended. Alternative: Single-ended unit substations No. 2, 3 and 4 can be provided when more substation capacity is required. If substations are made double-ended before second primary feeder is installed, a temporary cable may be run between the two transformers, Fig. 4, p 95.

And further growth. A second primary feeder usually is run in when more than four unit sub transformers are required. It may also be installed when the first double-ended substation is needed to save the temporary tie cable. The second feeder could, of course, be installed off bus No. 1. However, if we use the tie-breaker feeder as the second feeder, Fig. 5, then we can have two primary feeders and a full secondary selective system in the plant. This saves a shutdown while feeder No. 2 is being connected in. At the stage shown in Fig. 5, cost can be kept to a minimum by interchanging dummy and breaker elements between main and feeder positions. Reason: When a circuit breaker


Two feeders from utility with tie breaker between sections of split bus
Tie breaker, normally open
Double-ended unit substation

ULTIMATE DISTRIBUTION, using secondary selective setup, can be reached in planned steps without scrapping original gear or affecting production (see 7 steps, *right*)

Here are the steps for



1 Starting point for buildup may be the placing of main breaker as outlined

Why secondary selective?

There are many circuit arrangements used in industrial plants today (POWER, Sept 1957, p B-18). The simple radial is by far the most popular. One reason for leaning in favor of secondary selective is to satisfy needs for service continuity at reasonable cost. Failure of one primary feeder or transformer does not mean a total shutdown: affected areas can be fed through tie breakers.

is added in the tie-circuit breaker position, a circuit breaker should also be put in at the feeder position. So a new breaker element is needed for the tie.

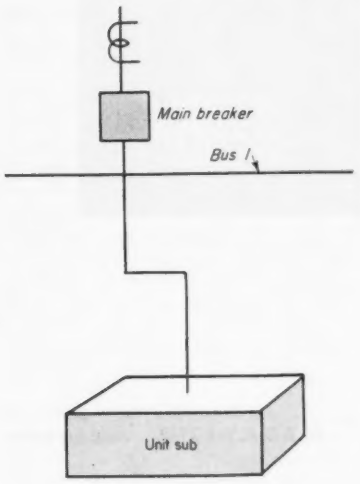
If we use the tie position for the second feeder, then we have to reconnect cable No. 2 when bus No. 2 is established. A still better scheme, however, is to add a position with a circuit breaker for second feeder. Then take the dummy out of first feeder spot and place it in the tie, Fig. 6. Then you have no future cable changes on the main bus; and no shutdowns are needed for cable reconnections. Second feeder position and its cable, and the lefthand side of unit substation No. 1, can be added and energized. A short shutdown would be in the cards while the breaker was being added in main position.

Now you have a system that can grow to about 30 mva with mere additions. However, before this system reaches that load, the utility must bring in another primary feeder. This calls for another main breaker which can be added by shutting down bus No. 2 and adding the new position. With the secondary selective system, all unit-substation secondary buses can be kept energized during this changeover. If you wanted to make this addition without shutting down bus No. 2, a main feeder position should have been added to that bus at some past step in the development of the power system.

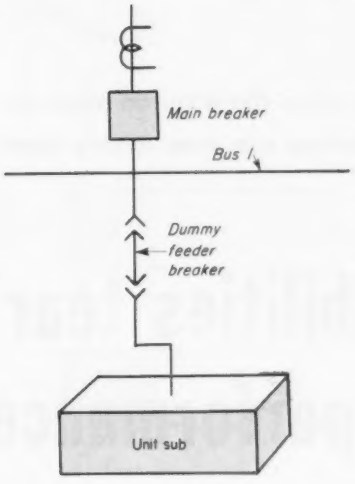
After the two main breakers and tie breaker are in place, and a secondary selective system is established, the added primary feeder positions and feeder and unit substations can be installed without shutting power completely off anywhere.

In many cases the power company would supply subtransmission power above 15 kv to this plant. In that case

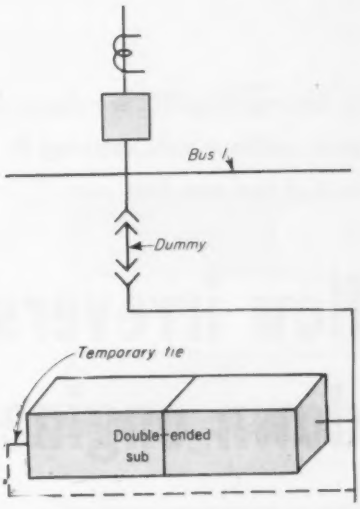
building a true secondary selective scheme from a simple one-sub plan



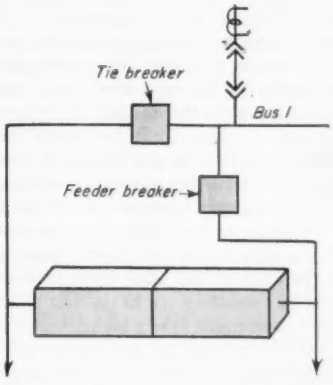
2 Another approach is to spot main breaker on incoming side of first bus



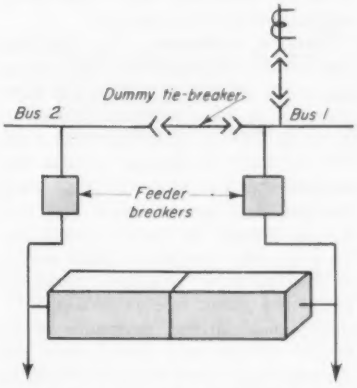
3 Providing for dummy feeder breaker and main breaker is a major step



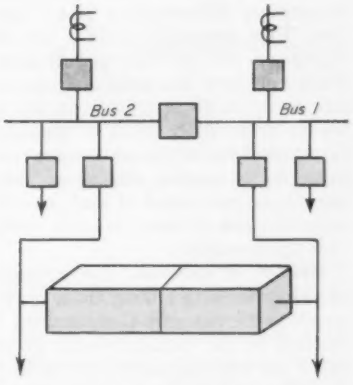
4 Double-ended sub bows in with temporary feed tied to original feeder



5 Now, tie breaker and feeder breaker serve as mains; dummy in main spot



6 Second dummy slides into tie-position while feeder breakers serve as mains



7 Utility brings in second feeders: ties, mains, feeder breakers are distinct

there would be transformers and subtransmission switchgear.

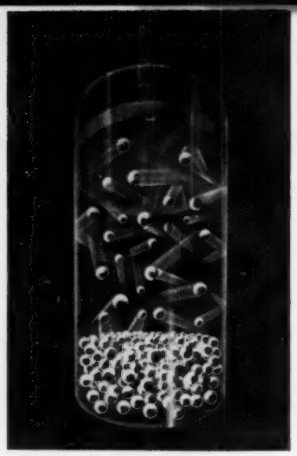
The synchronizing bus. This plant can grow further by using a synchronizing bus system. Synchronizing bus breakers may be operated either open or closed. If closed, reactors may be called for to keep short-circuit currents within limits. A look ahead will enable you to pick a reactor to allow many 4.16-kv bus sections, each with about a 7500-kva transformer, to be paralleled.

The payoff. In all this growth not one piece of equipment was added at any time that was not fully useful in the ultimate scheme . . . except one dummy breaker. Note that addition can be made by adding on, not rearranging or reconnecting what was previously installed.

Of course, any power system can be expanded if you want to spend enough money on it, shut it down for lengthy periods. But it's generally unnecessary since forward planning of circuit arrangement and equipment can avoid these expenses and losses. There is one basic rule that needs to be followed to get a system that can give you power-to-grow: Lay out a system for either a new or an old plant that is two or three times as large as present and then go back and design a system for the present plant load. Then the new system can grow into the ultimate system by merely adding on to it. This may require some small additions to the present system, but in no case will it mean scrapping what is now installed.

There are other important points which are really corollaries to that basic rule. For instance, select the proper voltage. Too low voltage can be a real bottleneck in any plant's growth. Select primary switchgear for main buses with maximum interrupting rating. Example: Select 250-mva switchgear for 4160-volt plant primary systems.

THERMO REFRESHER NO. 12



In thermodynamics we chase the will-o'-the-wisp, an ideal engine, without ever catching it. But we can come mighty close to it if we can find out . . .

How irreversibilities tear down engine performance

By B G A SKROTZKI, *Associate Editor*

► WE WERE TALKING about thermal irreversibilities in Part 11, August 1957. These are caused by the need for a temperature difference to make heat flow. They invariably cause a loss in engine or refrigeration performance. While we can't eliminate temperature difference, we do have a strong incentive to make it as small as possible. In practical engine design we must consider size of engine, amount of heat-transfer surface, speed of shaft, cost of materials, cost of fuels; in other words —design economics.

Internal vs external. The temperature drop we were talking about in reference to the visionary Carnot engine is external to the engine proper; so we call it an *external* thermal irreversibility. The engine also has an *internal* thermal irreversibility—heat can flow into the body of the working gas only when the cylinder head (where heat enters) is hotter than the gas. In addition, the gas nearer the piston face must be cooler than the gas next to the cylinder head during heat addition Q_a. This means there must be a temperature drop ΔT_a through the mass of gas, see figure *a*, panel, facing page, so it never can actually reach a uniform temperature.

During heat rejection Q_r, the gas next to the piston face must be hotter than the gas next to the cylinder head or the heat will not flow from the gas to the receiver. Making a detailed analysis of this condition becomes very difficult. We see from this that the gas temperature can never be uniform. To get around this practical difficulty some writers assume that a Carnot cycle works at a very slow speed so the temperature differences can be made so small as to be neglected. Obviously such a slow speed engine would not be practical.

Pressure variations. Our ideal-engine analysis assumes that the working gas at any one instant exerts the same pressure in all directions throughout its mass. This is reasonably true when the gas stays at constant volume and temperature, but when either property changes, local gas pressures vary during the change. In figure *c*, panel, facing page, when the piston starts moving to the right at a "practical" speed the gas at the piston face momentarily becomes more rarified, molecules in the body of the gas need time to move into the additional space made available by the piston. This sets up pressure waves in the gas that reduce the overall working force exerted on the piston during the working stroke. Severity of the pressure waves depends on cylinder dimensions, gas temperature and piston speed variation.

In figure *d* we see the condition for the compression stroke. When the piston starts moving to the left, the gas at the piston face momentarily squeezes into a smaller specific volume than the rest of the mass. This again sets up pressure waves in the gas that tend to raise the overall working force that must be exerted by the piston. We call this form of non-ideal gas behavior an *internal mechanical irreversibility*.

Gas chaos. Uneven pressure and temperature variations in a gas undergoing changes cause the molecules to be pushed in directions other than the random ones they would take in an undisturbed gas. We see the effect as eddies and vortices in the gas, figures *e* and *f*, facing page. This means that some of the molecules acquire momentary kinetic energies during expansion and compression that are not transmitted uniformly to the rest of the gas, and so can't act on the piston. In a sense the gas develops local hot spots that retain energy in the gas instead of passing it on to either piston or receiver.

When the gas momentarily settles to a condition of equilibrium at the ends of a piston stroke the kinetic energies of the vortices and eddy currents dissipate by spreading out to the rest of the gas and warming it to a higher temperature. In this way the gas retains more energy than it would under ideal conditions and reduces the thermal efficiency of the cycle.

We'll see later how we evaluate these losses in efficiency. The creation of unwanted gas motions in a cylinder is an *internal mechanical irreversibility*. Later in the series we'll see that these types of irreversibility are sometimes "built into" an engine to gain certain practical advantages.

Friction. In ideal engines we assume there is no such thing as friction. Looking at just the cylinder and piston we actually have two areas of friction: between (1) gas and cylinder (2) piston and cylinder. A practical reciprocating engine would also have frictional effects at crankpin and main bearings and other points of moving contact in its mechanical linkages. Figure *g*, facing page, shows the effect of energy transfer during the working stroke of gas expansion. The gas does total work

Energy flow depends on our ability to control irreversibilities

Irreversible effects

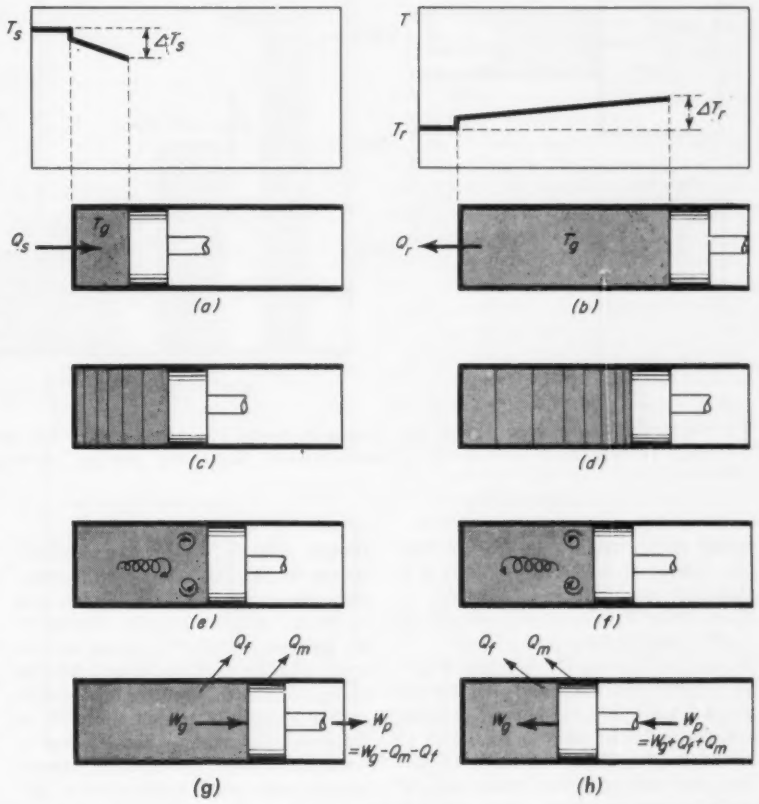
INTERNAL THERMAL—temperature drop needed to transfer energy as heat, causes loss of available energy by never letting gas temperature rise as high as the source temperature or as low as the receiver temperature. In "practical" cycles gas temperature is never uniform throughout its mass; temperature must drop in direction of heat transferred.

INTERNAL MECHANICAL—because actual gas cannot expand uniformly during quick changes, it sets up pressure waves that reduce pressure on piston below ideal during expansion; raises piston pressure above ideal during compression, *(c)* and *(d)*.

INTERNAL MECHANICAL—unequal pressure distribution and temperature variations in gas set up vortices and eddy currents that prevents some of the molecular energy doing useful work on the moving piston during expansion; raises work that must be done by piston on gas during compression, *(e)* and *(f)*.

EXTERNAL MECHANICAL—friction between gas and cylinder wall and between piston and cylinder wall dissipates energy to heat reducing net piston work during gas expansion; raising amount needed during gas compression, *(g)* and *(h)*.

Heat addition and gas expansion | **Heat rejection and gas compression**



W_g during the expansion. Most of it is expended upon the piston, but a small part goes to moving the expanding gas along the interior surface of the cylinder. This rubbing or frictional effect warms the surface of the cylinder above its normal temperature. The cylinder radiates this energy to the surroundings as heat.

Rubbing of the oscillating piston against the cylinder interior wall also warms the cylinder wall, the frictional heat being radiated to the surroundings. We need only apply the first law to find the effect of these energy dissipations. Work of the gas goes to supply the frictional heat dissipated and the net work developed by the piston on the piston rod; in equation form:

$$W_p = W_g - Q_f - Q_m$$

where

W_p = net work developed by piston
W_g = gross work developed by gas
Q_f = heat dissipated by friction between gas and cylinder interior wall
Q_m = heat dissipated by friction between piston and cylinder

So we see that mechanical work developed by the piston is less than total work done by the gas. This gives a strong incentive to reduce frictional losses to a minimum.

Figure *h*, above, shows energy balance during the compression stroke. Here the piston does work in compressing the gas. But part of this energy goes to supplying frictional losses and the remainder to actually compressing the gas; in equation form:

$$W_p = W_g + Q_f + Q_m$$

Thus the piston must do more work during compression than in an ideal engine. This type of loss is called an *external mechanical irreversibility*.

When we see the number and variety of irreversibilities it's easy to understand why practical engines cannot too closely approach the ideal in their thermal performance. It takes careful engineering to minimize these losses, as well as a thorough understanding of practical gas behavior and how it contrasts with the ideal concept.

Regardless of whether a piston compresses a gas or an expanding gas pushes a piston, the irreversibilities always cause a net loss in energy exchange.

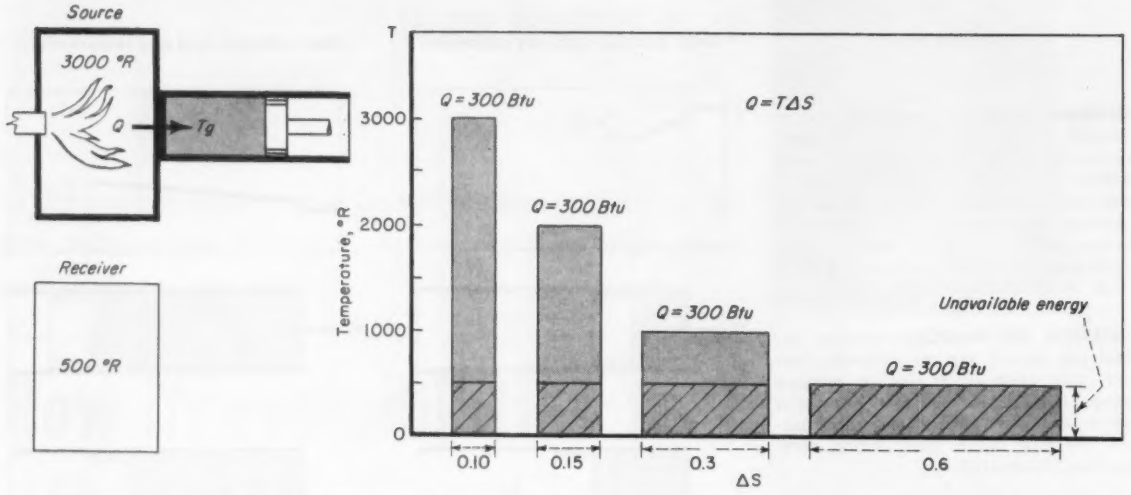
Entropy of energy. One of our major interests in thermodynamic processes is the estimating of energy loss. This can be measured directly as the conversion of *available* energy to *unavailable* energy by various irreversibilities. The most serious irreversibility usually is temperature loss during heat transfer.

To do this we can use the property, entropy. We have already learned that entropy is an abstract mathematical property of a fluid, Part 10, July 1957. When a fluid absorbs energy as heat its entropy increases, when it gives up energy as heat its entropy decreases. We can extend the idea of entropy by thinking of it as a property of energy. If we have a quantity of energy Q at a constant temperature T, then we can say that energy entropy change is:

$$\Delta S = Q/T$$

The energy Q could then be shown graphically on T-S co-ordinates as we did for gases.

In Fig. 1 we have a Carnot engine



1 We can assume entropy change also applies to energy instead of only as a property of a thermodynamic fluid. As we drop the temperature of a given quantity of energy, its entropy increases as well as the unavailable portion

taking energy from a furnace at 3000 °R. Energy $Q = 300$ Btu, and if it is absorbed reversibly by the engine so $T_g = 3000$ °R, then entropy change is:

$$\Delta S = 300/3000 = 0.10$$

We can plot this on the graph in Fig. 1 as a bar. The horizontal axis of the graph is not graduated in entropy units, but the width of bars is measured in entropy units; the area of the bar measures 300 Btu. If the lowest natural available receiver temperature is 500 °R, then energy at this temperature with a ΔS or 0.10 units will equal $T\Delta S = 500 \times 0.10 = 50$ Btu. We can superimpose this as the cross-hatched section on the first bar. The meaning comes easily: of the total 300 Btu at 3000 °R, 50 Btu is unavailable energy, 250 Btu is available for conversion to mechanical shaft work. The upper part of the bar is a T-S cycle diagram of the Carnot engine working between temperature limits of 3000 and 500 °R. The thermal efficiency of the cycle is:

$$e = (T_s - T_r)/T_s = (Q - Q_r)/Q$$
$$= 250/300 = 0.833 \text{ or } 83.3\%$$

Next let us assume that because of external thermal irreversibility that T_g must be at 2000 °R to accept the 300 Btu of heat from the 3000-°R source. We find the energy entropy change in the engine gas is now $300/2000 = 0.15$ units. It has gained 0.05 unit of entropy in dropping 1000 °R of temperature. The unavailable energy now has grown to $500 \times 0.15 = 75$ Btu and the available energy has shrunk to $300 - 75 = 225$ Btu. The corresponding thermal efficiency has decreased to $225/300 = 0.75$ or 75%.

In the third case, we let the gas temperature drop to 1000 °R. Entropy change rises to 0.30 and unavailable energy to 150 Btu making the thermal efficiency drop to 50%. In the last case we let the 300 Btu transfer directly to the receiver at 500 °R raising the entropy change to 0.60 units. All the energy, of course, becomes unavailable.

This gives us a graphic example of the penalty of running heat engines at low temperatures. For example, furnace temperatures in our modern steam generators run about 3000 °R, but the energy picked up by the steam is at 1000 F (1460 °R). Entropy of the energy more than doubles and the actual thermal efficiency is less than half the theoretical potential efficiency, figured from furnace temperature. At present, we are forced into this position because of lack of materials that can withstand temperature above 1000 F continuously. We do somewhat better with our internal-combustion engines which use hot gases to work directly on the pistons, but cooling them with water jackets forces the degrading of some high-temperature energy.

Irreversible processes. Now that we know the pitfalls of making engines run efficiently, how can we account for irreversibilities in calculating the various processes? Constant-pressure, -volume and -temperature processes by definition say what happens to these properties during a process. When we plot these processes on P-V and T-S diagrams, however, the areas under the curves no longer measure the amount of work done or the amount of heat transferred. The actual energy transfers will be either more or less than the theoretical amounts.

These deviations from theoretical are found by comparing practical tests with theoretical predictions. To emphasize the nontheoretical character of irreversible processes they are usually plotted with dotted lines on P-V and T-S diagrams. This automatically warns against placing any significance in the areas underneath.

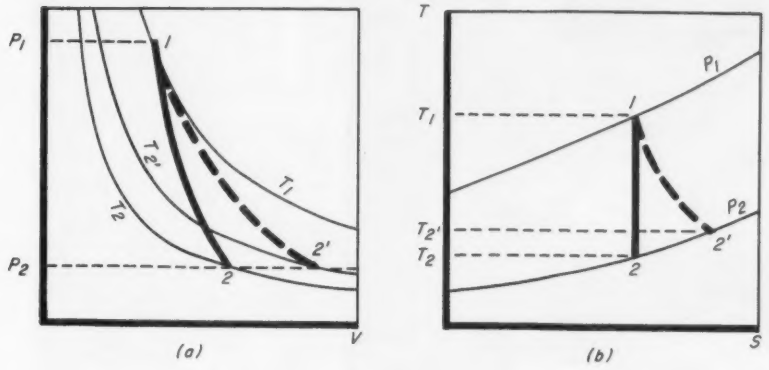
Adiabatic processes. You may have noticed that we did not mention an irreversible constant-entropy process above. Such a process is only accidental and has not much practical significance. You will recall that a reversible adiabatic process is a constant-entropy process which involves no transfer of heat. The solid curves *1-2* in the graphs of Fig. 2 show the ideal constant-entropy processes for expansion and compression of a gas.

An irreversible adiabatic process also involves no transfer of heat, but it does not take place at constant entropy. For an expansion, Fig. 2*a* and *b*, the process is often defined by the pressures P_1 and P_2 between which it works. Initial state at P_1, T_1, V_1 is the same for reversible and irreversible processes. But the two processes follow different paths and so have different end states, though they have the same pressure P_2.

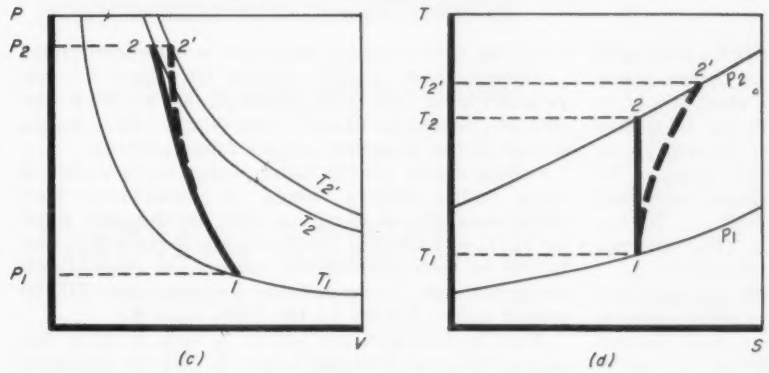
Because some of the energy stays in the gas during the irreversible process, see *e* and *f*, p 97, the gas has more internal energy at state *2'* than the reversible one at state *2*. So the temperature at *2'* is higher than at *2*.

The higher temperature gives *2'* a higher specific volume since $V = RT/P$. Its entropy is higher also, let's see why. Both processes end at the same pressure but the irreversible one at a higher temperature. Fig. 2*b* shows

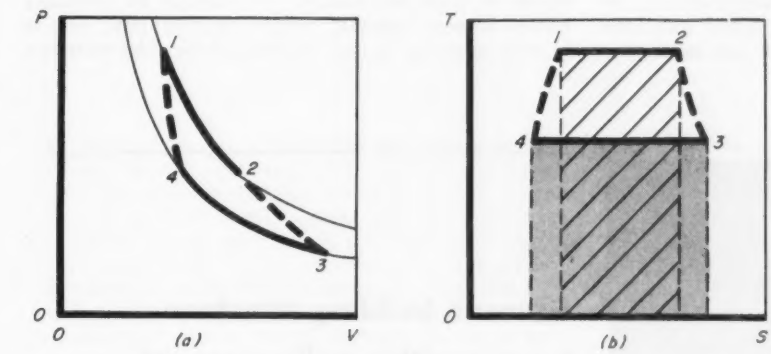
Irreversible adiabatic expansion



Irreversible adiabatic compression



2 During irreversible adiabatic processes no heat enters or leaves the gas, but the entropy of the gas always increases whether it is expanded or compressed



3 In a Carnot cycle with irreversible processes the net areas of cycle diagrams do not measure the net work done or heat transmitted; these must be calculated

that a pressure curve on T-S co-ordinates rises with increasing entropy and temperature. It follows that a gas with a higher temperature at a given pressure must also have a higher entropy. As we develop our study of thermo we'll find that an irreversible adiabatic process always involves an increase in entropy.

Referring back to Fig. 1, we can see that any process or cycling involving an increase in entropy will degrade available energy to unavailable energy. If there is a limited amount of high-temperature energy, high irreversibility means that we will get only a small amount of it as available energy. To stave off the fateful day of high-grade energy exhaustion we should make every effort to decrease irreversibilities where economically sound.

Fig. 2*c* and *d* compare the reversible and irreversible adiabatic compression processes. Here again we see that energy staying in the gas because of irreversible effects causes the end temperature to be higher; $T_{2'}$ is higher than T_2 even though $P_{2'} = P_2$. This again increases both the final specific volume and entropy of the gas.

Irreversible cycle. Now that we understand irreversible processes, let's see how they affect the Carnot cycle. Fig. 3 shows a Carnot cycle made up of a reversible constant-*T* heat-absorbing expansion process *1-2*, an irreversible adiabatic expansion *2-3*, a constant-*T* reversible heat-rejecting compression process *3-4*, and an irreversible adiabatic compression *4-1*.

Even though some of these processes are irreversible, the four state points are always the process terminal points. This means that the gas neither accumulates nor loses any net energy in regularly passing through the cycle of processes. Heat enters and leaves the cycle only during the constant-*T* processes. The difference in heat absorbed and rejected must equal the mechanical work output of the gas.

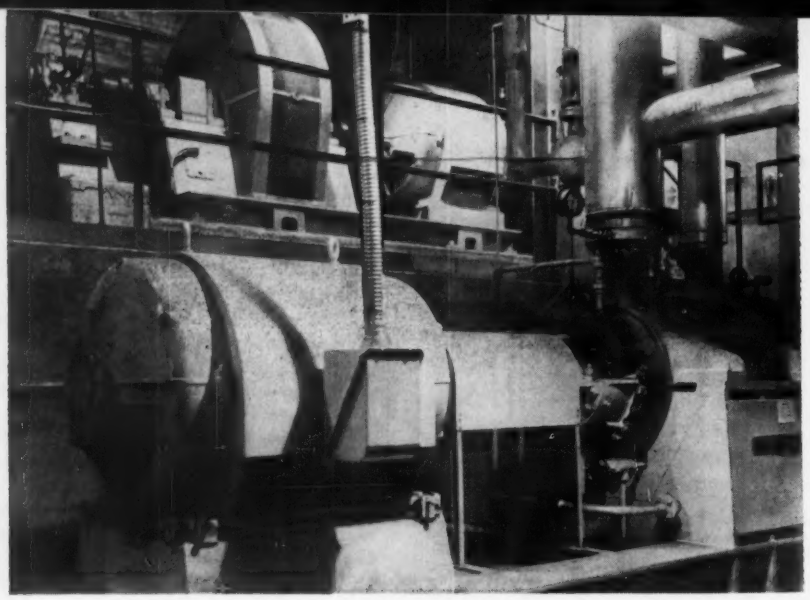
Easiest analysis can be made by studying the T-S diagram in Fig. 3*b*. Area under process *1-2* measures heat absorbed Q_a, since the process is reversible. Areas under the irreversible adiabatics *2-3* and *4-1* have no significance. But area under reversible process *3-4* measures the heat rejected, to the receiver, Q_r. Then, by the first law, the net work of the cycle is:

$$W = Q = Q_a - Q_r$$

This means that the net work output must equal the difference of the cross-hatched area under *1-2* and the gray area under *3-4*. This difference does *not* equal the net area enclosed by *1-2-3-4*. In fact, the difference is smaller than the enclosed area. It's possible for the net work to be zero if the irreversibilities become large enough.

By the same reasoning it should be clear that the net area on the P-V plane, Fig. 3*a*, does not measure the net work output of the cycle either. Net areas only measure net work when all the processes are reversible. Remember this in all future cycle analyses that we will make.

Next part will cover some ideal engine cycles—in a forthcoming issue.



Open-frame motors with silicone insulation beat price of TEFC Class B

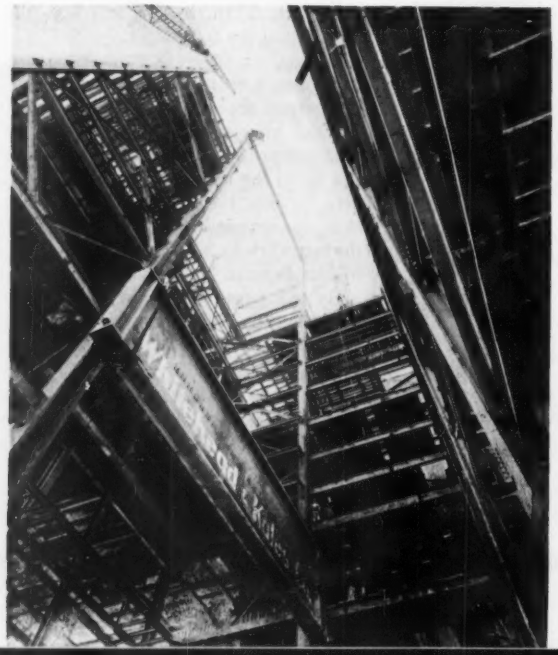
► ENGINEERS at Minnesota & Ontario Paper Co have made a tidy saving of some $28,000 on initial cost of their powerhouse motors. They claim windfall came about simply by specifying open motors with silicone insulation rather than TEFC frames with Class B. Four motors involved are in the new plant at International Falls, Minn. Size-wise the motors run 900 hp, 3600 rpm, driving 735-gpm boiler-feed pumps; 600 hp, 900 rpm for the induced-draft fan; 300 hp, 1200 rpm handling the forced-draft fan. There are two boiler-feed pumps. All motors are 2.3 kv, 3 phase.

Using open dripproof frames, some felt the pulverized coal dust in ventilating air might pose a tough abrasive problem on any insulation. However, the final decision favored silicone in open frames, at 62% the cost of Class B in TEFC frames. In manufacturing, every stator coil was wrapped with two different types of silicone rubber tape. For straight insulation, the first layers were unsupported, semi-cured silicone-rubber tape. For abrasion resistance, the last layer was made of the same tape backed with glass cloth. Semi-vulcanized for handling ease, both tapes were cured out after wrapping, forming a moistureproof jacket.

Although these materials insulate the motors for temperatures in the 180C (Class H) range, they are being operated at conventional Class B temperatures. Extra margin is held in reserve against possible future overloads.

Looking closely into the dollar picture, the total claimed saving tallies $28,340. Here's the breakdown: Each 300-hp open silicone motor cost some $5600 against $8600 for TEFC with Class B. The 600-hp motor ran a little over $10,000 for open-frame silicone compared to about $17,000 for the alternate. And each 900-hp motor cost about $15,000 stacked against $24,000 for the TEFC Class B.

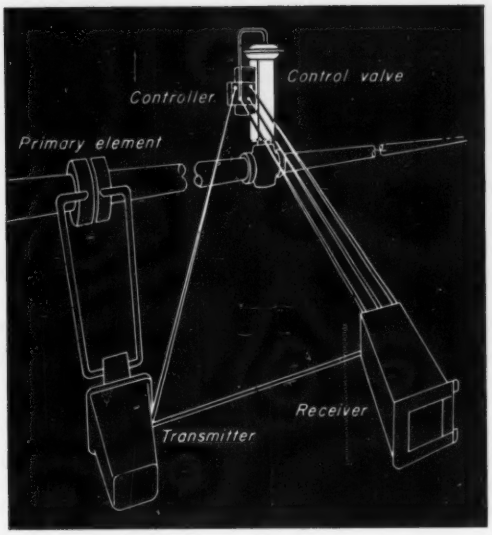
What the long term cost will be is hard to say at this stage of the game. Installed January 2, 1957, the auxiliaries have been in continuous service, with no apparent trouble. Looking back over the past few years, hardly a month has gone by without some motor manufacturer announcing a change in either the materials or technique for insulating motors. Changes generally involve adopting glass, silicone or other synthetic coatings in place of the older materials.



Greased building structure helps position boiler support

► PROBLEM: Raise a 55 x 14 ft, 70-ton girder over 14 stories into position as main boiler support for No. 5 turbine at Detroit Edison's St. Clair River power plant. Whitehead and Kales, a Detroit steel firm solved it by greasing edges of the existing structure, then lifting girder into place with two 3-sheave pulleys and a 1-in. steel cable.

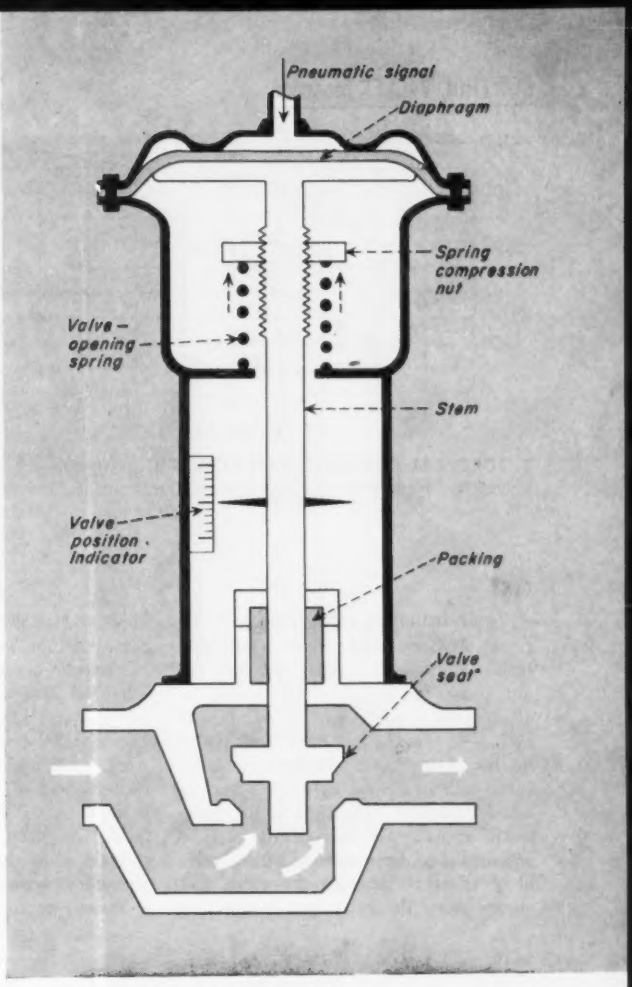
Giant gantry cranes were used on each side for steadying. Gusty winds delayed the operation for a week, but once started, the girder slid into place in less than 1½ hr.



Last article in a series on flowmetering

Control valves

By **M R SKROKOV**, *Formerly with Taylor Instrument Companies*



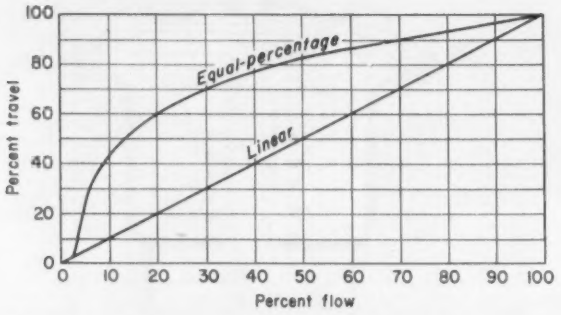
PNEUMATIC CONTROL VALVE is actuated by air-pressure signal on diaphragm against spring biasing

► THE CONTROL VALVE determines the flow of liquid or gas in response to signals from the controller. Of principal interest in flowmetering circuits are throttling valves rather than simple open-and-closed valves. Throttling valves today are mostly pneumatic actuated, and for this reason we'll omit discussion of electric valves. Previous articles in this series, POWER, Feb 1956, Aug 1956, Feb 1957, took up primary elements, transmitters and receivers—the other links in the flowmetering chain.

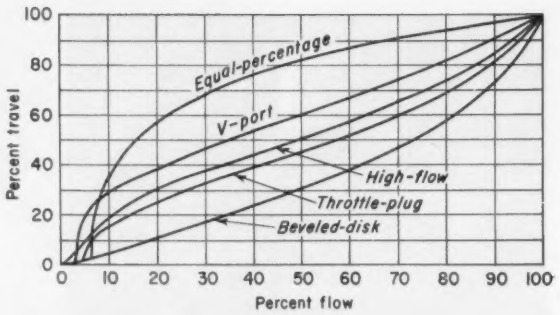
Sketch, above, shows a simple control valve. Pneumatic signal depresses diaphragm, forcing down valve stem against tension of biasing spring. Travel of stem is proportional to air pressure and disk can be held stationary in any position between the open and closed points to achieve the required corrective action in the flow circuit. Control valves are mostly of the disk type, but there are many variations on the disk. Unlike a manual valve, the stem slides back and forth without rotating.

Because control valves perform more exacting functions than manual valves, they must be selected with greater care. Important decisions in selecting control valves concern (1) valve size (2) body material, pressure rating and end connections (3) valve action (4) seat and disk construction (5) trim material of seat, disk and stem (6) type of pneumatic motor and spring rating. (See POWER, Nov 1955, pp 82-86 for a discussion of these six points.)

Valve construction tries to provide flow-control function to match process needs. Linear processes, which are those with a constant load condition, require a linear control-valve function. Control engineers today usually specify, wherever possible, a simple flat-seated, or bevel-disk, single-seat valve body and rely upon the controller for the control function necessary for the control loop. Nonlinear processes have a varying load (for example, a Btu change in a steam-flow line caused by steam-pressure variation), and may require an equal-percentage valve function. Curves, top of next page, show theoretical linear and equal-percentage valve functions, and actual characteristics of some typical valve designs. Some manufacturers have combined, to some extent, linear and nonlinear characteristics in one valve body construction. One such construction is the high-flow type whose characteristic curve is shown in group, top of next page. Curve shows that this valve body construction limits the flow during roughly the first 25% of the valve travel. During the balance of travel the valve approximates characteristics of the linear or flat-seat type.



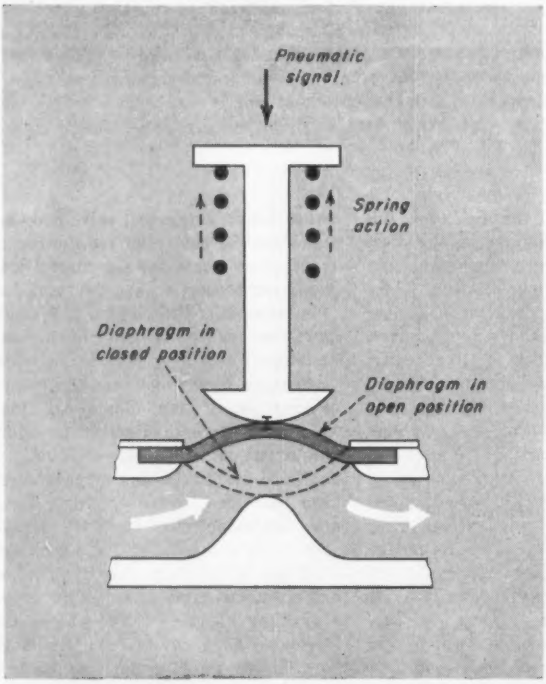
THEORETICAL CHARACTERISTIC CURVES of pneumatic control valves for linear and equal-percentage throttling of fluid flow



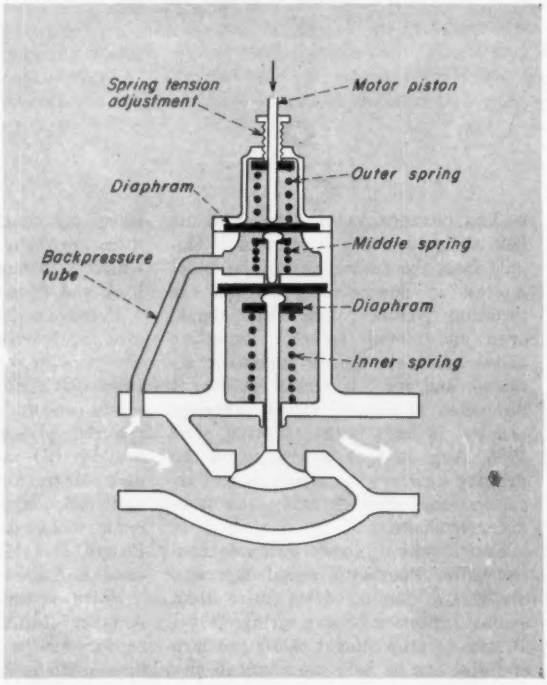
ACTUAL CHARACTERISTIC CURVES of typical valves which approach the theoretical curves for most of their range

Valve action is either direct or reverse. A direct-acting valve is one that tends to close when the pneumatic signal produces force on its stem (the air-to-close valve shown at *A*, top of facing page). It can be called a normally open valve. A reverse-acting valve is held closed by spring biasing and is opened by the force of the pneumatic signal. Reverse action can be accomplished by a reverse-acting valve body as at *B*, wherein the valve disk moves below the valve seat in order to open and allow fluid passage, or by a reverse motor, as at *C*. A reverse motor is one wherein the pneumatic signal is admitted into a space below the diaphragm instead of above it. Thus the pneumatic force exerted on the valve stem pulls up against the spring tension instead of pushing down. If the valve is to fail closed, that is, shut off fluid flow when control is lost due to a leak somewhere in the pneumatic signalling system, it must have either a reverse-acting valve body or a reverse motor. Note that in each case the fluid flow is in such a direction as to oppose closing the valve. This avoids slamming and chattering as the disk approaches the seat.

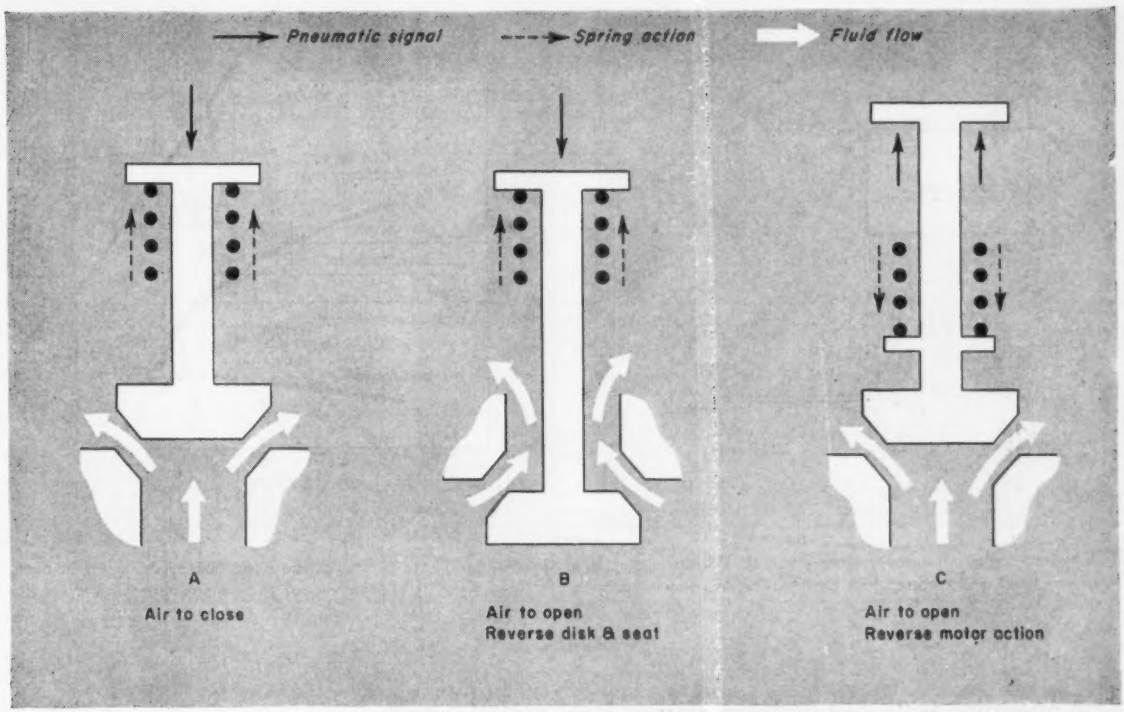
Valve action must be of a particular type in order to produce the kind of corrective action called for by the controller in a flow system. For instance, if we assume a direct-acting flow controller and a direct-acting control valve in a flow control loop, the direct-acting controller will produce an increas-



SAUNDERS PATENT VALVE controls flow with a rubber diaphragm which eliminates the need for a stem packing gland



BACKPRESSURE VALVE is designed for some types of refrigeration duty. It's sealed by signal-transmitting diaphragms



VALVE ACTION is direct when the air signal is used to close valve *A*. Reverse valve action is accomplished by a reverse disk and seat *B*, or a reverse-acting pneumatic motor *C*. Signal acts to open the valves in the types illustrated by *B* and *C*

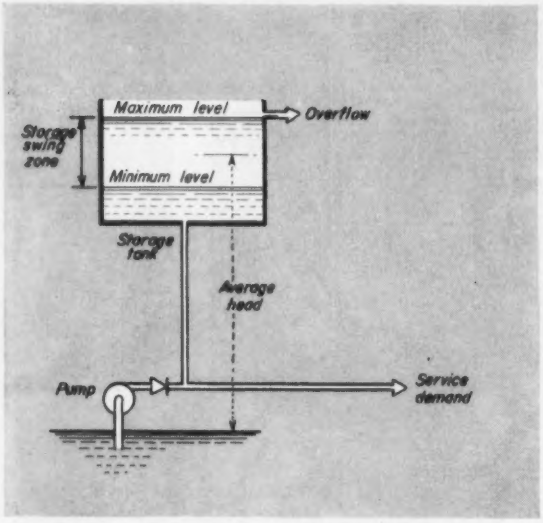
ing pneumatic signal if the flow has gone beyond the set point of the controller. (See POWER, Feb 1957, pp 98-101). This greater pneumatic signal tends to close the direct-acting valve. Closing the valve, either wholly or partially, as called for, corrects the flow in the system.

Valve size, valve action and rangibility (the range of flows a valve will pass from its wide open to its almost closed position) are important factors when two, three or more valves are used in one control loop. This is especially the case in flow circuits where flow rate is varied over a wide range (say 200 or 300 to 1) while maintaining constant pressure. Since rangibility of average control valves is approximately 30 to 1, a number of overlapping valves will be required. The valves are overlapped only slightly, so that when the first valve is fully open, the next larger valve has already cracked, or moved away from its seat by a small amount. Valve sizing is very critical in this type of problem. The type of valve action would be the same for all valves in the series since they would all have to open progressively. In a heating and cooling problem, however, the hot-fluid valve would have an opposite action to that of the cold-fluid valve.

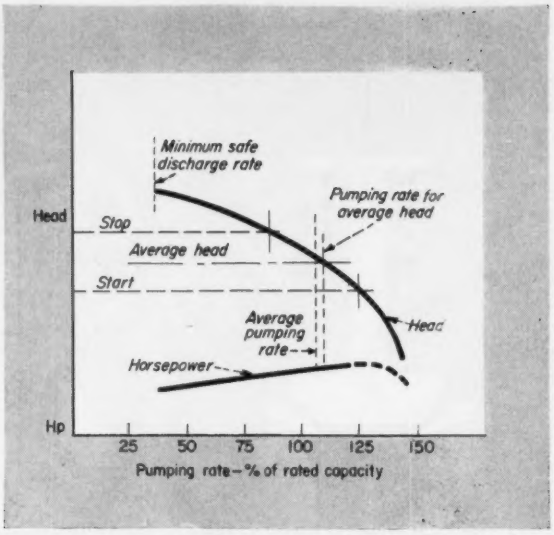
Multiple-valve control loops have to operate all the valves from the available pneumatic control signal. Most controllers put out a signal of from 3 to 15 psi. A direct-acting valve would be fully open at 3 psi and fully closed at 15 psi. If the valve has a linear characteristic, it would be at the midpoint of its travel at 9 psi. In the multiple-valve circuit, however, the available signal must be divided among the valves. If, for example, four valves were to be used in one loop, when 12 psi was available, only 3 psi would be had to operate each valve. Reducing the valve spring tension to compensate for the weakened signal would make it difficult to maintain the desired valve characteristics (linearity in the case just mentioned), and might produce undesirable effects such as wire-drawing and hysteresis on the valve stem and unbalanced forces across single-seated valves. Rather than change spring tension, valve positioners are almost always used to amplify the signal to the individual valve. Valve positioners, POWER, Nov 1955, p 86, are mounted on the valve-motor housing and operate on principles similar to the principle of the controller itself.

Special valves may be required to handle certain processes most effectively. The Saunders Patent valve, bottom, facing page, has a heavy rubber diaphragm instead of a disk. Since the fluid is sealed in, a packing gland is unnecessary. The rubber diaphragm is acid and abrasive resistant. This type of valve is especially useful for slurries, paper stock and fluids with solids in suspension. Butterfly valves are used where the pressure drop has to be small while the line size is large. Pressure drop is in the order of inches of water instead of pounds. Some special-purpose valves incorporate some control functions into the valve itself. The backpressure control valve, bottom, facing page, are used for ammonia and freon service. Valves of this piston type, employing the packingless connection shown, eliminate possibility of leakage. Backpressure at the inlet side is varied in order to maintain a constant temperature regardless of fluctuations in the cooling load.

Lever motors are an adaptation of control-valve motors. In place of the valve proper there are linkages arranged to operate a damper or other device. Applications occur in air-conditioning and boiler-damper control.



1 Elevated tank maintains system pressure. Pump is started at low level and stopped just before reaching the overflow



2 Pumping rate climbs as the head decreases. Rate at average head is slightly higher than mean start-and-stop rate

Pump operation with start-and-stop storage-level control is one good way to control a fluid system. But for trouble-free performance be sure to . . .

By J B RICE, *Ebasco Services Inc*

Balance pumping rate, storage capacity

Three trouble sources

Swing zone too small

Causes large number of pump starts which can overheat the motor or damage the starter or the circuit breaker

Swing zone too large

Big storage-level changes can cause too much variation in supply pressure. Reserve storage at low level may not be enough if there is a pump failure. Reserve must carry the process and/or give industrial fire protection

Tank not high enough

Liquid level may then affect supply pressure. So low water level is kept as high as possible. As a result, the swing zone may be greatly restricted

► START-AND-STOP pump operation with a storage tank is often the best way to control a water supply or a process fluid. It is especially good when (1) demand may drop below the minimum safe operating level for the pump (2) demand occasionally exceeds pump capacity (3) reserve storage is needed to guard against pump or power failure.

But for trouble-free operation, both storage-tank capacity and pumping rate must be carefully balanced. Box, left, gives three common sources of trouble with this arrangement.

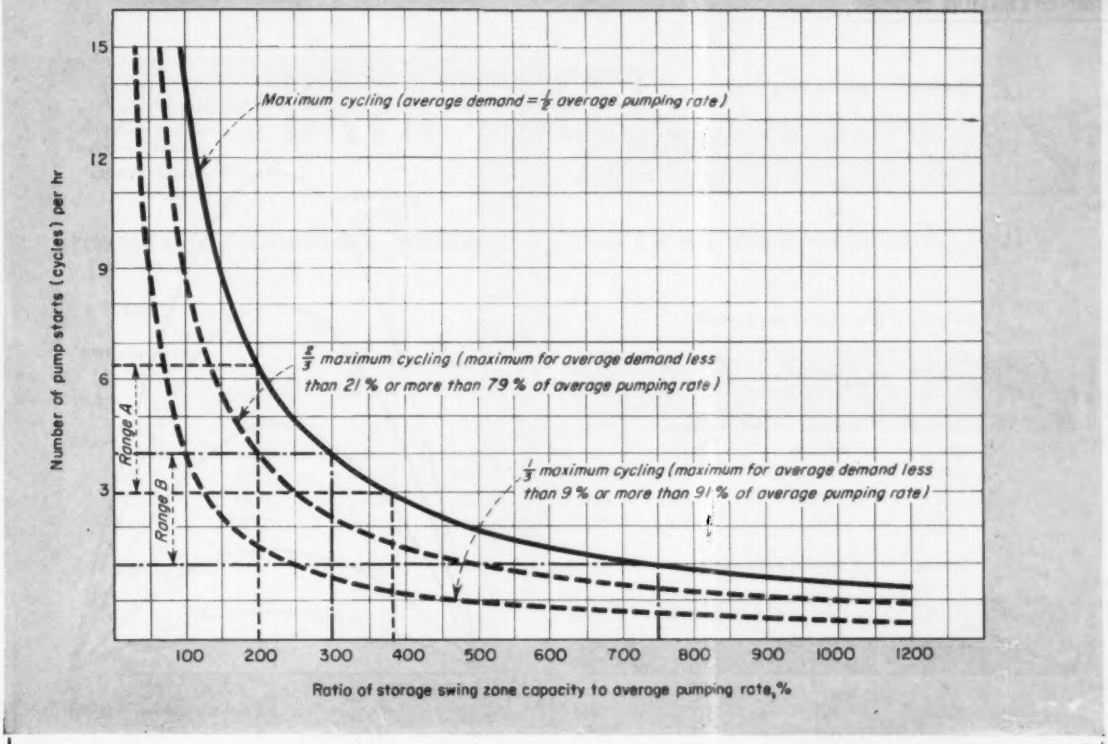
Flow diagram, Fig. 1, shows the operation of a typical system. Pump discharges both to the overhead tank and to service.

Operation is almost the same as a system where the pump discharges directly to storage and service demand is taken only from this overhead tank.

The pump starts when tank level drops to the minimum and stops when it nearly reaches the overflow. Control is usually automatic. Float switches, pressure switches or probes are connected to the pump-motor starter. Often high or low level alarms or both are included. But, level differentials needed to operate them are taken from available swing-zone storage.

Pump characteristics are shown in Fig. 2. Note that decreased head permits greater discharge. In general, horsepower increases with the discharge rate; but some pumps do have decreasing power requirements for head flow conditions beyond rated capacity. Keep above the minimum safe-discharge rate to prevent overheating and destructive rotor vibration.

Discharge rate of the pump con-



Use this chart to select swing-zone capacity

Chart gives the maximum cycling rate for storage-swing-zone capacities up to 12 times the pumping rate.

Range *A*, above, covers 4 to 7½ cycles per hr (8 to 15 min operating cycle). Avoid over 7½ cycles per hr. Range *B* covers 2 to 5 cycles per hr. This may be excessive for larger pumps. Avoid over 5 cycles per hr. Check with pump motor and starter manufacturers in each case for their specific recommendations.

Storage swing zone can be reduced without danger of too frequent starting if demand never (1) calls for more than a small fraction of pump capacity or (2) falls much below the average pumping rate for the system.

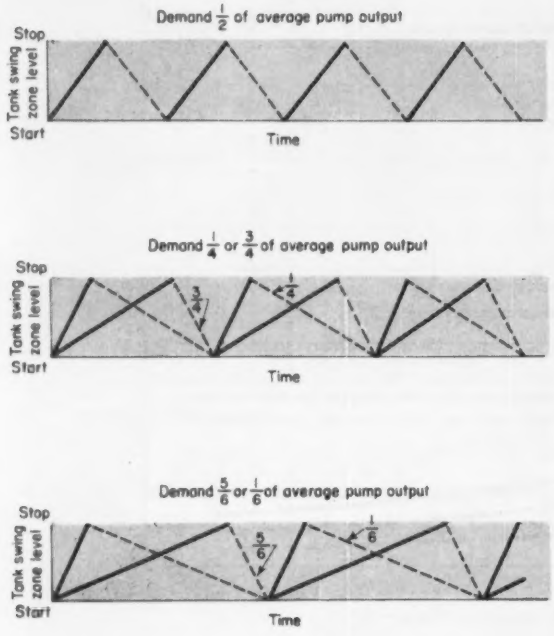
Base storage-swing-zone capacity on the maximum cycling curve if demand (1) varies over a wide range for more than a few minutes or (2) is between ¼ and ¾ the average pumping rate for a ½-hr period or more.

nected to the tank in Fig. 1 decreases as the level in the storage tank rises. Note that the pumping rate for the average head is higher than the mean start-and-stop rate. But if the pump always discharges above storage-tank water level, head and pumping rate are constant. This arrangement is often preferred because tank-supply piping and pump are isolated from plant distribution piping.

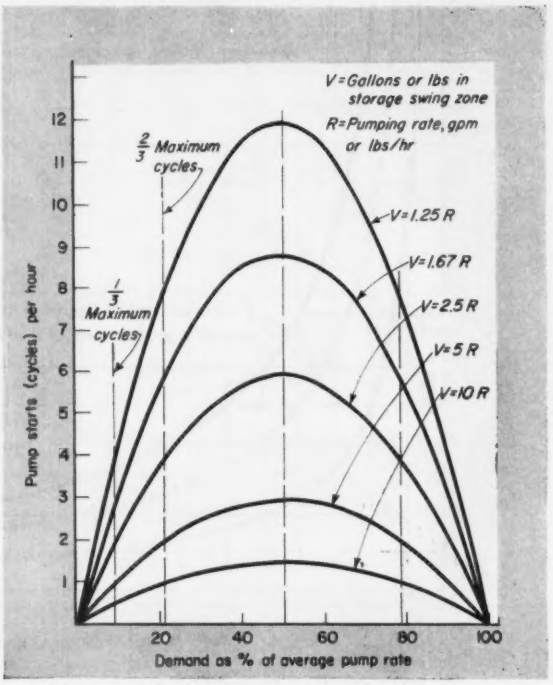
Tank water level variations are shown in Fig. 3. There is no cycling if demand is zero, or if demand equals the pumping rate. When demand averages half the average pumping rate there are one-third more stop-and-start pump cycles than when demand is either one-quarter or three-quarters the pumping rate. For example, if the demand is 50 gpm and the pumping rate 100 gpm, the tank will also fill at 50 gpm. A storage tank containing 500 gallons will fill or empty every 10 min; so the cycle time is 20 min for a total of three cycles per hr.

Now let's take the same pumping rate of 100 gpm and storage-tank swing capacity of 500 gallons with a service demand of 25 gpm. The tank will fill at 100 minus 25 or 75 gpm. This takes 500/75 or 6 2/3 min. It empties in 500/25 or 20 min. Total cycle time is then 26 2/3 min. This amounts to three cycles in 80 min.

Calculations to establish the proper balance between pumping rate and tank capacity can be very confusing. But the following rules simplify the



3 Liquid level varies with demand and average pump output. Level is steady when demand equals zero or the pump rate



4 Upping storage capacity of overhead tank swing zone will reduce the number of pump start-and-stop cycles per hour

problem: (1) When tank swing-zone capacity is five times the average amount of fluid pumped per minute, the pump operates a maximum of three times an hour. (2) Maximum cycling rate occurs when demand averages half the average pumping rate. (3) Maximum cycling rate for a given job is proportional to the ratio of pumping rate per minute to storage swing-zone capacity. (4) Maximum cycling per hr is equal to 15 times this ratio. If pumping rate is one-tenth storage capacity, the maximum number of cycles per hr is 1½.

Family of curves, Fig. 4, are plotted from this kind of data. Cycles per hr are given for various ratios of storage capacity to pumping rate. Demand varies from zero to 100% of the average pumping rate.

Chart, preceding page, helps to check swing-zone capacity and pumping rates. Plant engineers will find these curves particularly useful when faced with the problems of (1) using tanks and pumps that are incorrectly sized (2) adapting existing equipment to a process change and (3) meeting new fire insurance requirements and revised concepts of reserve storage. The curves help to (a) present these problems to management or process men and (b) determine the changes in storage or pumping capacity that will conveniently or economically give a satisfactory pump cycling rate.

Sometimes these problems can be solved by putting an orifice in the pump discharge line to reduce discharge rate. But consult the pump builder if the pump must be restricted to less than half its discharge capacity. Hazardous rotor and shaft vibration often make this impossible. Establish minimum safe flow obtainable without pump overheating. This is important if the pump is operated for even short periods at less than one-quarter of its rated capacity. If there are a number of duplicate process units, investigate the use of a single pump to supply several process storage tanks at once.

New operating conditions may call for the pump to perform at much lower heads and higher flows. The pump manufacturer can be very helpful in tackling this problem. Pump suction characteristics, cavitation and head-flow curve for the new conditions must be carefully studied.

Pumps that are too large can sometimes be altered for new conditions by machining down the rotor diameter. For pumps that do not develop enough head, it may be possible to insert a rotor of larger diameter. This is only possible if the pump has a rotor of smaller diameter than the maximum for which the casing was designed. If all this fails, then consider buying another pump specifically designed for the revised operating conditions.

System difficulties can also be caused by insufficient storage in the swing zone. Swing-zone capacity is limited by the distance between the tank overflow connection and the minimum permissible operating level. If the lower limit is set by minimum head requirements, try setting the tank at a higher elevation.

If volume is the problem you may be able to reduce the pump discharge rate as previously outlined. The only other recourse is to add more capacity or change the process program. The final answer might even be that start-and-stop operation is not practical for the new conditions. In that case, automatic flow control with low flow recirculation of excess capacity is the alternative solution.

Power's DATA SHEET

No. 303

Stresses for seamless condenser tube (with desuperheater), psi

Steam pressure psig	Metal wall temp F	Admiralty	90-10 Cu-Ni	80-20 Cu-Ni	70-30 Cu-Ni	Red brass	Monel, stress-relieved	Monel, annealed	Copper, light and hard drawn
50	332.66	8690	9104	10,169	10,669	6694	19,402	15,271	6040
100	372.88	6625	8863	10,008	10,463	5085	19,281	14,990	3856
150	400.85	4966	8693	9849	10,297	2983	19,200	14,799	
200	422.77	4089	8518	9763	10,209	2545	19,200	14,777	
250	441.20	3352	8370	9653	10,135	2176	19,200	14,759	
300	456.73		8192	9560	10,073		19,200	14,743	
350	470.64		7970	9476	10,017		19,200	14,729	
400	483.13		7770	9401	9967		19,200	14,717	
450	494.53		7587	9333	9922		19,200	14,705	
500	504.99		7420	9260	9890		19,200	14,700	
550	516.59		7235	9167	9867		19,200	14,700	
600	523.81		7119	9110	9852		19,200	14,700	
650	534.00		6956	9028	9832		19,200	14,700	
700	540.42		6853	8977	9819		19,200	14,700	
750	549.54		6707	8904	9801		19,200	14,700	
800	555.33		6625	8847	9779		19,200	14,700	
850	563.62		6509	8764	9746		19,200	14,700	
900	568.90		6435	8711	9724		19,200	14,700	
950	575.26		6346	8647	9699		19,200	14,700	
1000	581.36		6261	8586	9675		19,200	14,700	
1050	587.26		6178	8527	9651		19,200	14,700	
1100	592.94		6099	8471	9628		19,200	14,700	
1150	598.44		6022	8416	9606		19,200	14,700	
1200	603.75			8347	9592		19,174	14,700	
1250	608.90			8275	9582		19,138	14,700	
1300	613.90			8205	9572		19,103	14,700	
1350	618.75			8137	9562		19,069	14,700	
1400	623.46			8072	9553		19,036	14,700	
1450	628.05			8007	9543		19,004	14,700	
1500	632.50			7945	9535		18,972	14,700	

► THESE STRESS VALUES are used to calculate thickness of seamless condenser tubes in desuperheating zones, when the higher pressure is inside the tube. Use with these formulas:

$t = (P \times d)/(2S + .8P)$ for straight tubes, and

$t = (P \times d)/(2S + .8P) \times (1 + d/4R)$ for U-bends

where dual-gage tubing provides greater thickness in the bent section than in the straight section.

t = tube wall thickness, in. (before bending)
d = outside diameter of tube, in.
P = design pressure, psig
S = allowable design stress, psi
R = radius of bend at center line of tube, in.

For determining material and thickness in desuperheating zones, tube metal temperature is assumed to be not more than 35 F above the saturation temperature corresponding to design pressure on the shell side. (Outside desuperheating zones, tube metal temperature is assumed equal to this saturation temperature, as explained in *Data Sheet* No. 302, POWER, August 1957, p 99.)

All values in the table are for tension, not compression. They represent stress and tension created by the higher pressure inside the tube and the lower pressure outside it. Values have been interpolated from the 1956 ASME *Code*.

GEORGE F HAUSENBAUER, *Alco Products, Inc*

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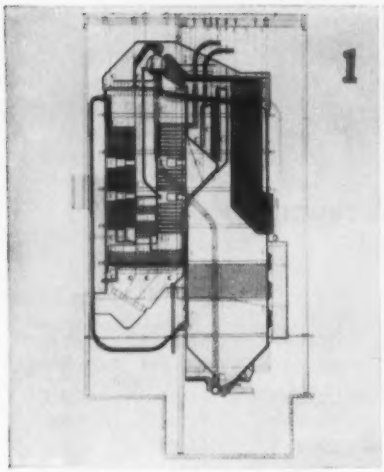
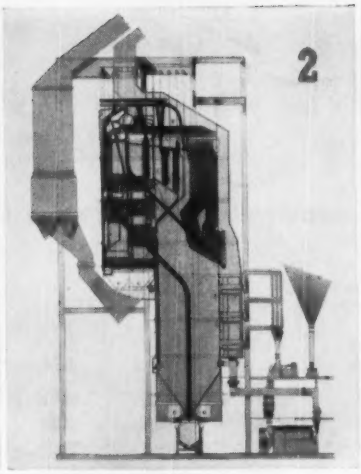
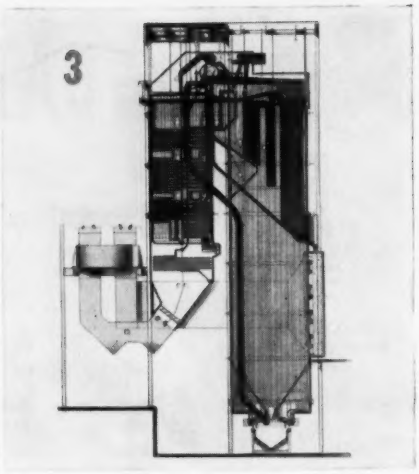


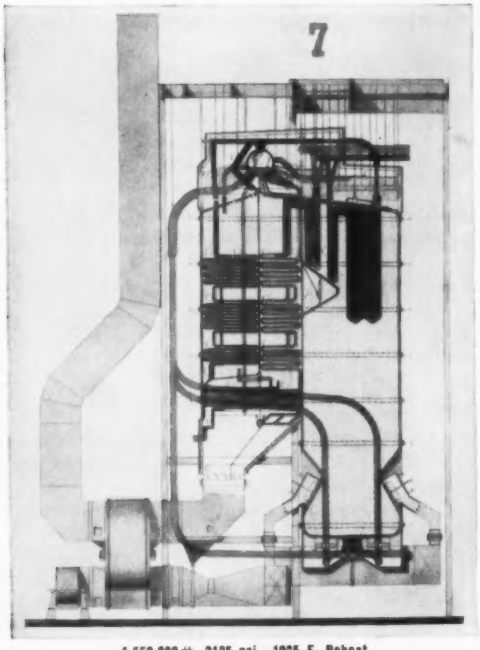
600,000#, 1760 psi., 1000 F. Reheat



1,000,000#, 2075 psi., 1005 F. Reheat



690,000#, 1650 psi., 1000 F. Reheat

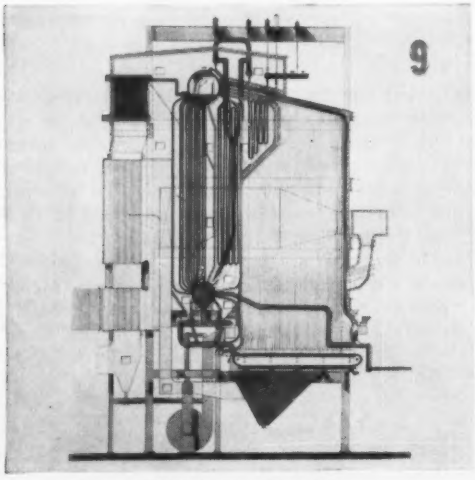


1,550,000#, 2125 psi., 1005 F. Reheat
TURBO FURNACE

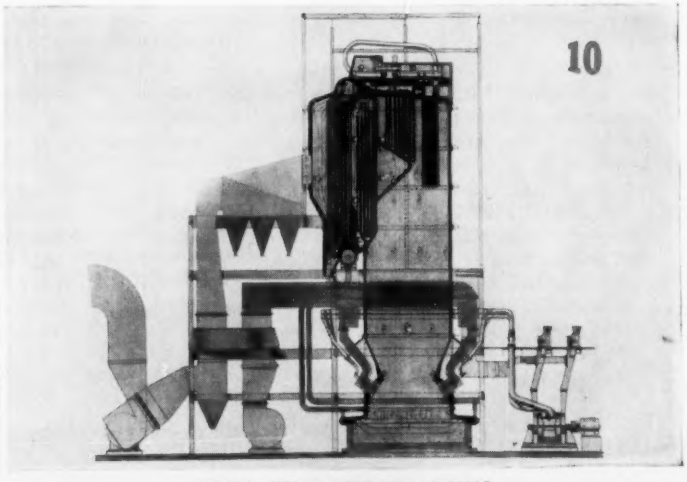
RILEY CENTRAL

that cover a wide range of

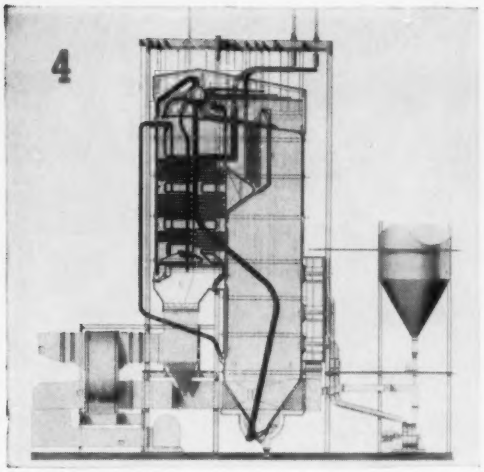
1. Florida Power Corporation — Oil
2. Public Service Company of Indiana, Inc. — 4 Units — Coal
3. Central Illinois Light Co. — Coal
4. Minnesota Power & Light Co. — 2 Units — Coal, Future Oil, Gas
5. Dallas Power & Light Co. — Gas, Oil, Future Lignite
6. Texas Electric Service Co. — Oil, Gas
7. Louisiana Power & Light Co. — Gas, Future Oil, Coal
8. Texas Electric Service Co. — Gas, Oil, Future Coal
9. Montana Dakota Utilities — Lignite
10. Delaware Power & Light Co. — 3 Units — Fluid Coke, Gas, Oil, Coal
11. Central Louisiana Electric Co. — 2 Units — Gas



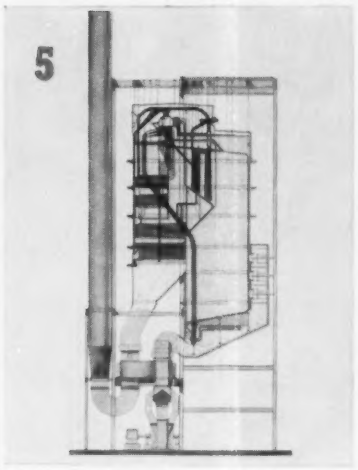
250,000#, 1025 psi., 905 F.



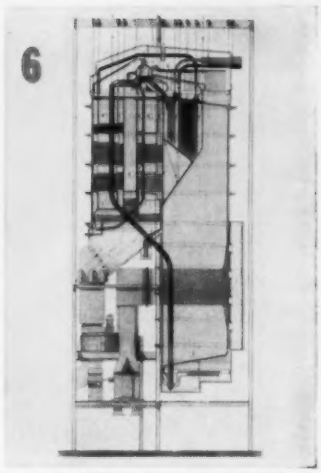
500,000#, 1425 psi., 950 F. TURBO FURNACE



500,000#, 1726 psi., 1005 F. Reheat



1,050,000#, 1725 psi., 1085 F.



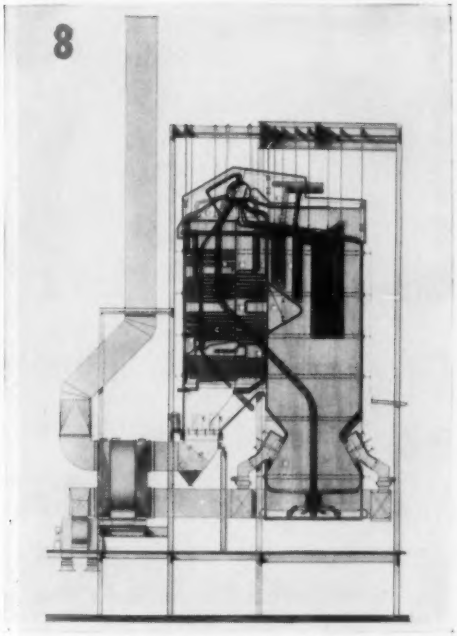
1,200,000#, 2125 psi., 1005 F. Reheat

STATION INSTALLATIONS

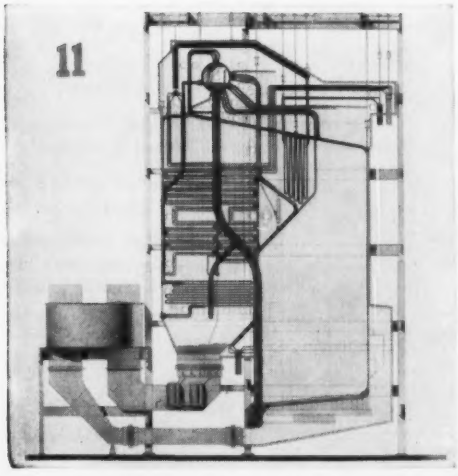
typical operating characteristics

These Riley Central Station Boiler designs are typical of many units that have been sold in recent years to a growing list of public utilities. This gratifying acceptance is a result of not only dependable and efficient operating characteristics, but because Riley, with its wide range of fuel burning products and the recent development of the TURBO FURNACE for multi-fuels, can offer the most economical solution to virtually any fuel burning situation.

Riley Boilers and Fuel Burning Equipment are *Designed, Manufactured, Erected and Serviced* under a single contract.



825,000#, 1750 psi., 1005 F. Reheat
TURBO FURNACE



350,000#, 1650 psi., 1005 F. Reheat

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

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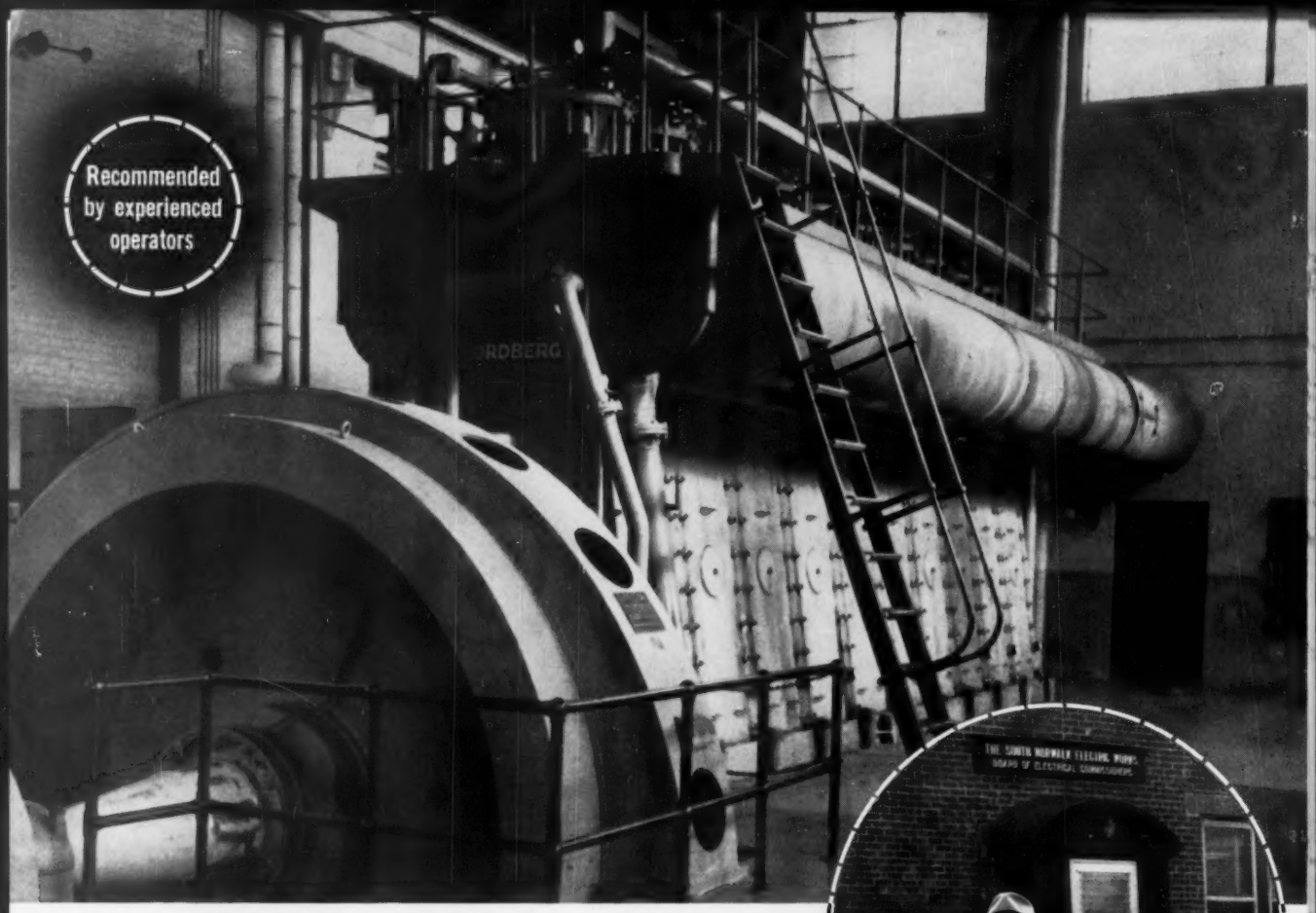

"confidence in Nordberg . . . we have purchased two additional engines since our first installation"

The South Norwalk Electric Works, South Norwalk, Conn., has a long and successful record of supplying reliable electric lighting and power service to its customers. Playing a major role in providing this dependable power are three big Nordberg 2-cycle engines, totaling 10,250 hp.

Mr. E. J. Splan, Gen'l. Supt., speaking for the Board of Electrical Commissioners, has this to say about Nordberg engines *and* Nordberg *service:*

"*Our confidence in Nordberg engines is best expressed by the fact that we have purchased two additional engines since our first installation. We were pleased to find that Nordberg's interest in a customer did not cease with the sale of an engine, and after 17 years of business association that solicitude remains the same. We consider them a friend as well as a supplier of excellent Diesel engines.*"

These, then are additional reasons why experienced operators rely on *Nordberg* to provide the best answer to municipal and industrial power problems.

When you need *long-term, dependable* power, consult Nordberg . . . builders of America's largest line of heavy duty engines, including Diesel, Duafuel® and Spark-Ignition Gas types.

Nordberg Mfg. Co., Milwaukee, Wisconsin.

. . says Mr. E. J. SPLAN, Gen'l. Supt., South Norwalk Electric Works

●

Installation Data . . .

1940—Installed Nordberg 3,000 hp Diesel, rated 2,000 kw.

1942—Installed second Nordberg 3,000 hp, 2,000 kw Diesel.

1951—Installed third Nordberg Diesel . . . a 10-cylinder unit rated 4,250 horsepower, 3,000 kilowatts.

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

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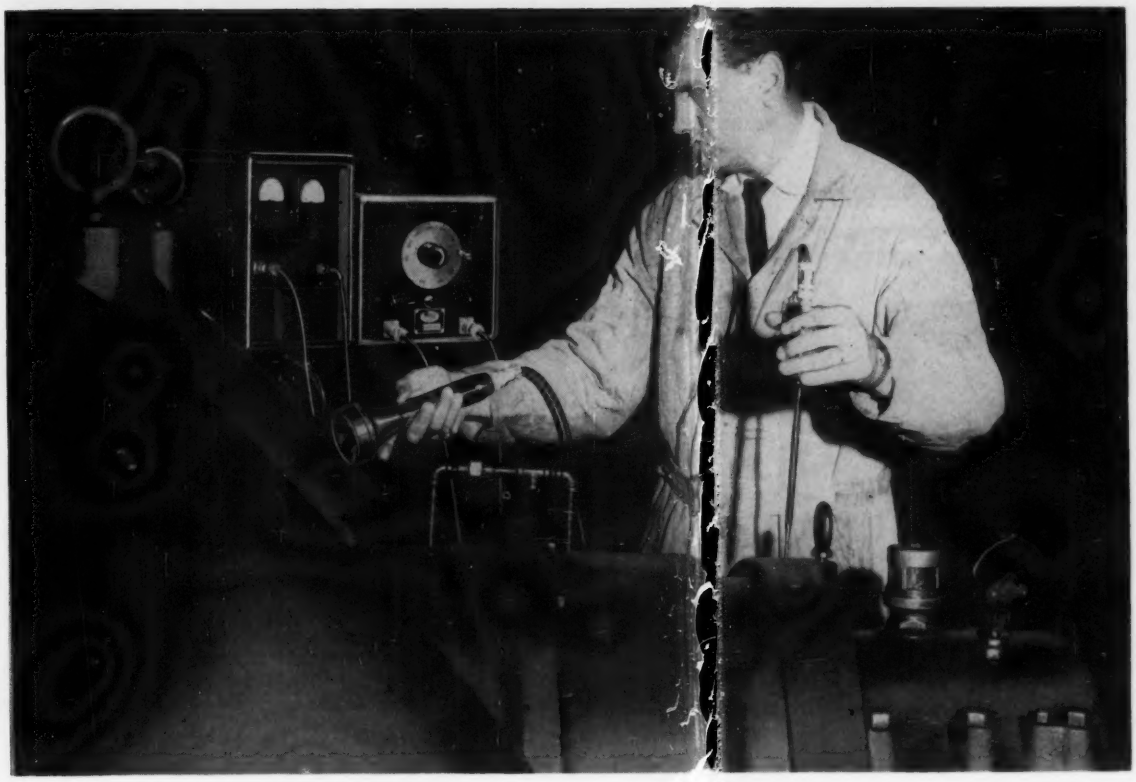
P957

STEVE ELONKA
Associate Editor in Charge



OLD TURBINE gets its monthly physical with electronic equipment

Today's ace trouble shooter: Your vibration analyzer

By GERALD L BOURDAGES
International Research & Development Corp

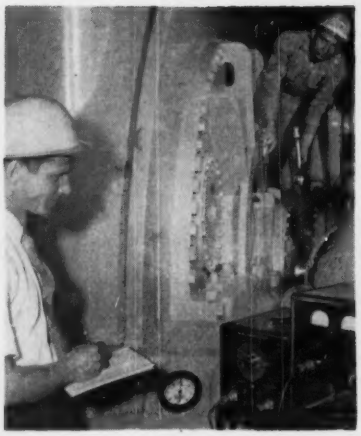
► NOW, ELECTRONICS replace "trained fingertips" and "educated screwdrivers" in detecting and measuring vibration and correcting imbalance of rotating machinery. Let's compare the old and new methods.

We'll suppose your turbine has the shakes, but there's a long time before the next scheduled shutdown. You have two alternatives: sit tight or try to repair the turbine. You decide to stop and make repairs; so your man with the "trained fingertips" is called in to do the job. If he's lucky, he might pinpoint the source of vibration. If he thinks imbalance is cause of vibration, he adds weights here or there and restarts the machine. By now, everyone is holding his breath. Will she work better or shed her bolts?

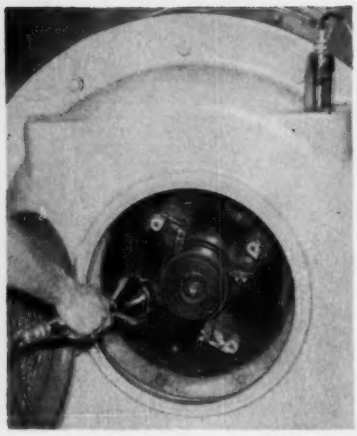
Let's say your man is lucky. After several guesses with his fingertips or screwdriver, the vibration is reduced. While a coin won't stay on edge, a bolt will stand upright on the exciter housing.

Now let's do it the scientific way. We'll replace your old-time vibration expert with an electronic vibration shooter. First, place the pickup of the vibration analyzer on the

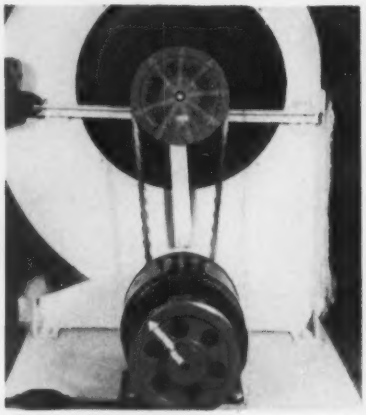
1 First, operator takes a reading at the bearing of turbine-generator's exciter



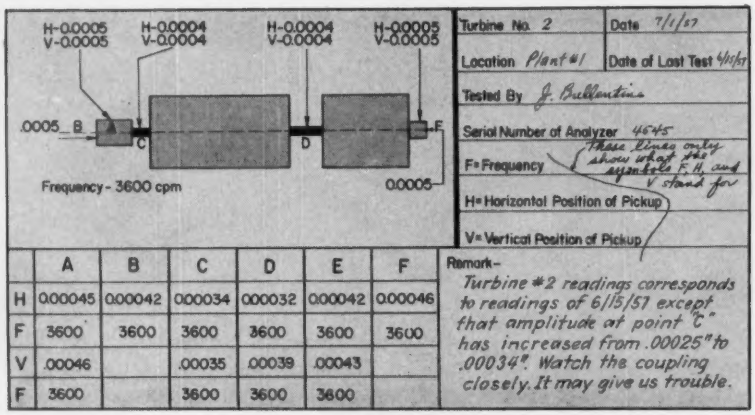
2 Next, bearings *B*, Fig. 8 below, are checked with the vibration analyzer



3 Stroboscopic lamp provides "window" by revealing phase of the imbalance



7 Stroboscopic light reveals the phase, location, or angle of the imbalance



	A	B	C	D	E	F
H	0.00045	0.00042	0.00034	0.00032	0.00042	0.00046
F	3600	3600	3600	3600	3600	3600
V	.00046		.00035	.00039	.00043	
F	3600		3600	3600	3600	

Remark – *Turbine #2 readings corresponds to readings of 6/15/57 except that amplitude at point "C" has increased from .00025" to .00034". Watch the coupling closely. It may give us trouble.*

8 Log sheet can be drawn up with spaces to record the vibration readings and location of reading point for every piece of equipment. File and compare with old

First, you pinpoint vibration with this trouble shooter . . .

exciter-bearing housing. Meter shows a 4-mil vibration displacement there. Next, place the pickup on the bearing housing between the turbine and generator; here the meter reads 5 mils. Then, check the governor and housing; meter reads 3 mils.

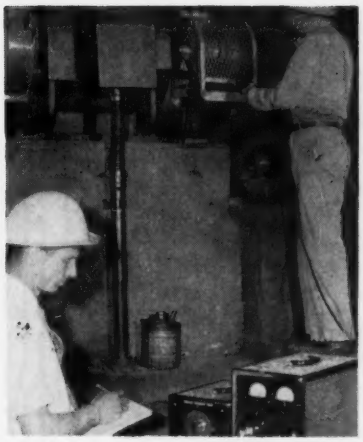
Within a few minutes, your maintenance man has a complete summary of the vibration conditions of both stationary and rotating components of your turbine. He finds most vibration is in the turbine itself. To complete his analysis, he opens the exciter-shaft cover and places the pickup at the important points of measurement. With a flashlight-type stroboscopic lamp triggered by the pickup, he learns the phase of imbalance in the turbine by viewing the end of the shaft.

In this case, balancing is done by using a scientific procedure. The electronic system indicates both the amount of correction needed and the proper angle at which the correction must be made. Result: Vibration level is reduced to a maximum of four-tenths of one mil at any measuring point. And the facts are right—nothing is left to chance.

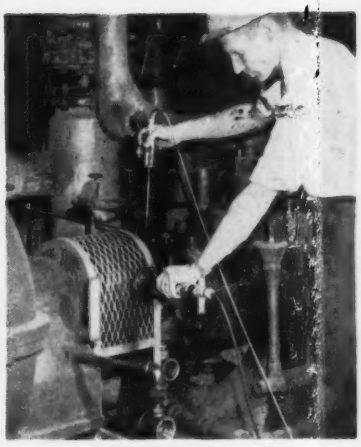
Using electronics to trouble-shoot, measure vibration and dynamically balance turbines or other components is a fairly new concept. So let's take a closer look at the wonder tool just discussed.

Vibration analyzer. This particular electronic system, called a vibration analyzer, consists of an inductive type vibration pickup with a probe. It detects the vibration and converts it into an electric signal. This signal is passed to electronic circuitry contained in a portable console. Amplitude or displacement of the vibration is registered directly in thousandths of an inch on a meter.

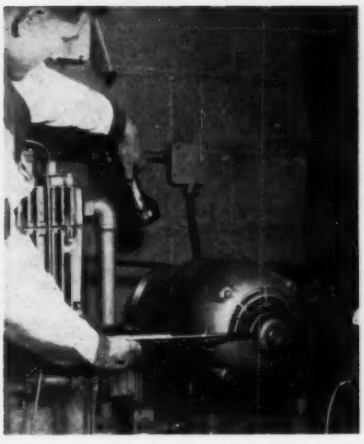
Another meter records either the frequency of the dominant vibration or, after a variable filter is turned on, selectively tunes to any or all frequencies in the mechanized system. An electric signal also triggers a stroboscopic light in synchronization with the frequency of the vibration. This allows you to observe the angle of imbalance. Viewing the rotating part under the stroboscopic lamp gives the illusion that the part is standing still. Various models are available for frequency ranges of 300 to 160,000 rpm.



4 Fan bearings are checked, readings are accurately recorded on log sheets



5 Main feed-pump bearings get same treatment during monthly checkup



6 Belt of the motor driven compressor is checked by using pickup probe

9 Having determined imbalance, excess metal is ground from blade. This brings fan within standard tolerance quickly

10 Weight is added to rotor after vibration analyzer has detected imbalance. Eliminates guess work, does job right

then, you correct cause accurately and quickly

Typical results obtained with the equipment: (1) Located a high vibration in a blower system. A stroboscopic lamp inspection (with the stroboscopic lamp triggered by the vibration pickup) showed three gear teeth were broken from the main gear drive. Further running of the blower would have caused a failure of the entire gear system.

(2) Using the old trial-and-error method, maintenance men had torn down a blower assembly and replaced the bearings three different times over a relatively short period. This electronic system located a bent shaft as the cause of the trouble.

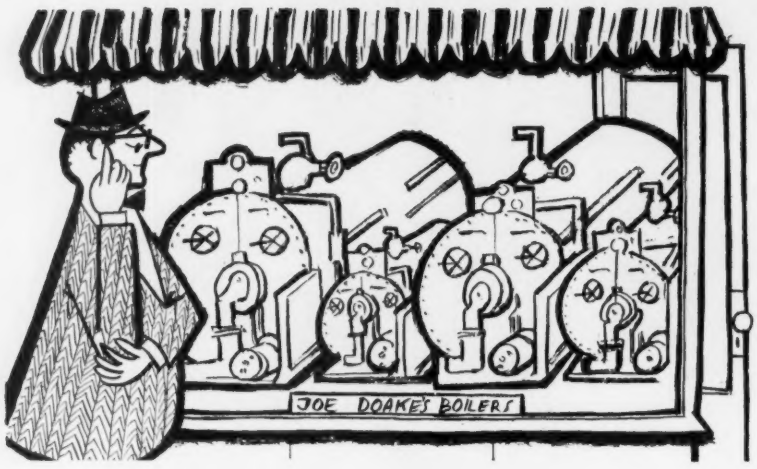
(3) Maintenance men were making a periodic checkup on a 450-hp motor with this electronic system. Vibration level was not excessive but the frequency was higher than usual. That pointed to a change in bearing conditions. Inspection showed dry bearings. This also prevented possible breakdown of several other motors purchased at the same time.

Preventive maintenance. Use of electronics is not limited to trouble shooting; the Potomac Edison Co, among others, uses this equipment in its preventive maintenance program.

For turbine-generators, log sheets are drawn up with spaces to record the vibration readings and locate reading points, Fig. 8. Readings are taken periodically. If amplitude or frequency increases over previous readings indicate remedial measures should be taken, plans can be made for repair or replacement of the defective parts at an opportune time.

Instrument measures three fundamental parameters of vibration: displacement, frequency and phase. Knowing these three important, basic functions on all types of rotating equipment you can: (1) Measure displacements—to determine when permissible vibration tolerances are exceeded. (2) Analyze or trouble-shoot—to locate the faulty components exciting the vibration when tolerances are exceeded and to balance dynamically. (3) Locate the phase or angle and amount of imbalance—so you can correct it without costly dismantling. Since vibration is usually the first warning of impending danger, this instrument can be your most important preventive maintenance tool.

By WM B FIRMAN
Orr & Sembower, Inc



Buying a packaged firetube boiler?

If so, these tips may save you money now and during the life of the unit

► THE PACKAGED FIRETUBE BOILER becomes more popular as time goes by for several reasons. First, it's delivered as a one-piece unit and quickly installed. Second, being automatic, it takes little attention and fits neatly with today's trend to automation. Third, its operating efficiency is high, mainly because a single manufacturer, rather than various component suppliers, is responsible for the entire unit. This feature also eliminates a lot of service headaches.

Some misconceptions exist, however, concerning selection, installation, operation and maintenance. It's important that these phases be understood because the packaged boiler often serves as the heartbeat of the plant's production.

How to select your boiler

"Let's get a boiler with enough capacity to supply our needs when we double production," is a typical statement by a prospective purchaser. This is sound thinking and can result in economies. But it depends on how soon you'll need the reserve capacity. If it's five years, you'll be operating inefficiently throughout that period. You'll be better off buying the size you need now and adding a second unit when demand goes up. But, be sure to allow enough space for installation of the second boiler.

Another misconception involves price. A plant we know "saved" $500 by selecting a boiler on price alone. Two years later, maintenance costs had mounted to the point where replacement with a quality unit had to be recommended. Boilers are no different than most capital equipment. You may pay a little more for the best, but you'll save a lot more in the long run.

Plant people should have a hand in boiler selection. Very often it's left to the architect or contractor. There's nothing wrong with this provided you make sure the consultant knows exactly what you need. You're the one who has to live with the final choice. Here are some items most commonly overlooked when selecting a boiler:

Pick the right size. This is especially important if you have lots of on-off cycling in your operations. A too-big boiler costs real money in wasted fuel.

Don't buy "specials" unless your problem can't be solved any other way. Standard models give you proved design, best possible operating economy.

Consider boilers in "series" if you need more capacity than any one unit can give. Several units side-by-side may give needed capacity, yet keep sizes small enough so state or city law won't require constant attendance.

Have your boiler salesman talk to the people who'll operate and maintain the unit. Let him determine just what capacity you need. In line with this, if your boiler will supply process equipment, don't depend on the equipment manufacturer to give you exact steam requirements. He may not know, strangely enough, and costly errors have been made by plants that didn't realize this. Have your boiler salesman make a complete study of the process equipment. He is trained to do this. Moreover, he must have the information to be able to correctly size your boiler.

Should you specify gas-and-oil-combination firing? This depends on your locale. Some gas companies won't give you service unless you have provisions for instantaneous switchover. Your proximity to the gas fields is another big factor. It's always wise to have an "out" in case any one fuel becomes unavailable.

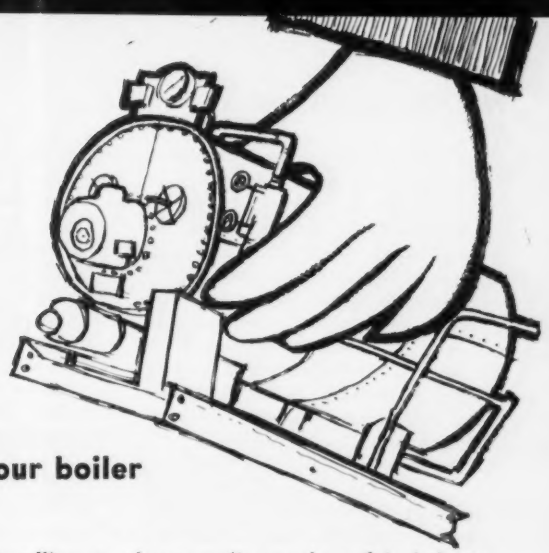
When buying an oil-fired unit that doesn't include a gas plenum as standard equipment, it's a good idea to have one shipped with the boiler. Then if you want to change to gas, the burner and accessory equipment can be installed with little effort. Many oil-fired boiler purchasers don't ask for the plenum because they don't know about it.

Protective controls. Make sure your boiler has protective controls. If you're planning to operate without constant attendance, you should have audible alarms to indicate low water or flame-failure shutdown. The latter control should have interlocks so the boiler can't be started again until blower has cleared the furnace of explosive gas.

Climate. Don't select a boiler for Arctic temperatures if your climate isn't that cold. Many boilers purchased today are being specified with a design that allows for heating with outside temperatures at –10 F. This weather may have occurred in your area only ten times in the last twenty years. The boiler will do the job if it gets that cold, but otherwise you've got a big, inefficient unit.

Investigate parts and service availability before buying a packaged boiler. Be sure you know what you face if you should need parts or service in a hurry.

Ask for fire testing of your boiler under field conditions similar to yours *before* it's shipped to your plant. Reputable manufacturers will do this and give you a copy of the entire test report. It's your insurance against getting a poorly functioning boiler.



How to install your boiler

Many people think that installing a packaged boiler is a matter of "drop it in place, hook it up to services and you're in business." While this is correct to a certain extent, it's important to be ready for the boiler's arrival. By proper preparation, you can save valuable time and headaches after delivery date. This includes attention to details of steam, water and fuel piping, electrical supply, draft and noise control. To be sure preparation is complete, get your boiler salesman's help. He can, and should, provide counsel and see the job through to actual start-up. Be sure to get start-up service with operating tests written into your contract; or allow for the extra expense if you call in an independent service outfit. Here are some other items you should consider:

Burning heavier oils generally means providing for a way to warm oil in the storage tank to get suitable pumping viscosity. Oil temperature shouldn't be less than 100 F at the pump suction. If you use a steam-coil in the storage tank, condensate should be discharged through a trap to the sewer to avoid possible boiler water contamination.

Temperature regulating valve should be used in the steam line to the coil. This will avoid fuel pump vapor lock caused by high oil temperature. Run the steam line to the coil in intimate contact with the pump suction line and encase both in a common insulation. This will keep the oil warm and free-flowing in the line.

Fuel-oil piping must be big enough. If piping diameter is too small, the viscous oil can cause high friction losses and prevent an adequate supply of oil at the burner.

Provide enough clearance around the boiler for ease of inspection and maintenance. Don't fail to allow space at front or rear of boiler for getting cleaning tools through the tubes and for tube removal.

Discharge piping from the safety valve must be supported. Letting the dead weight of the piping rest on the safety valve could have serious consequences. This is commonly ignored despite the fact that this support is required by law in many areas.

Stack conditions are important. You need the advice of a competent boiler-installation engineer in order to insure that draft conditions are exactly right. Any reputable boiler manufacturer will provide this service.

Your power supply must have electrical characteristics identical to those for which the boiler is wired. A stable voltage is essential because low voltage may interfere with control function.

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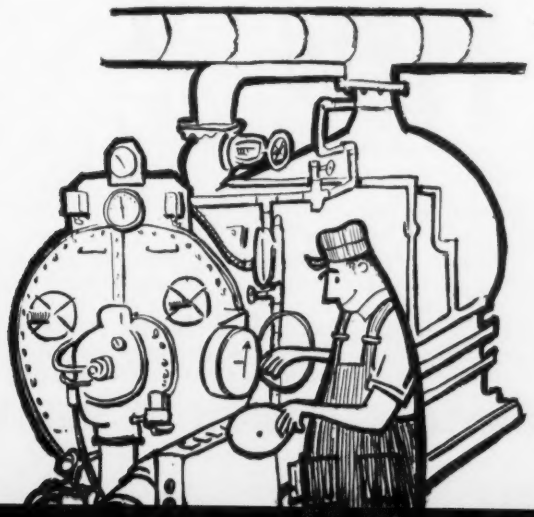


How to operate your boiler

Regardless of how automatic a piece of equipment is, it still needs supervision. And the packaged boiler is no exception. You must keep it clean and make sure your operating people under-

stand that it *is* a piece of machinery. It's probably the most important piece of equipment in your plant. Yet in many plants, the boiler receives the least attention. Tack the manufacturer's operating instruction chart in full view near the boiler. Have your boiler salesman provide your operating people with adequate information when the unit is installed. He can be very helpful in making them understand what they need to know and why. Here's what to guard against:

Beware of thermal shock. First, don't let excessively cool return condensate or feedwater enter the boiler. Provide some means for tempering the water. Second, select pumps and controls to put water in the boiler at a rate no higher than required to supply heat to the load. Third, direction of flow through the boiler must be maintained. Introduce water only through the normal feed connection unless you get specific approval from the manufacturer to do otherwise.

Watch stack temperatures to keep a check on boiler efficiency. If the stack temperature gradually rises over an extended period, some operating condition isn't right. However, be careful in accepting any specified low fluegas exit temperature as the right one. It can depend on where the stack thermometer is located. The closer it is to the boiler, the better the reading. It's possible to have an overfiring problem without realizing it until too late.

Watch the fuel pressure closely if firing with gas. A gas pressure change must be compensated for by adjusting the firing-rate controls. Overfiring often results when this isn't done. Check gas pressure at regular intervals even though your boiler is equipped to maintain firing rate automatically. If you're firing propane, be sure to check your ratings. The heat value (Btu per cu ft) of propane gas is more than twice that of natural gas.

Check fuel costs periodically. This is your best indicator of how your boiler is operating. Poor fuel efficiency can mean your boiler needs anything from a minor adjustment to a major repair. Ask your boiler salesman what your fuel bills should be—or check cost of first year of operation against present costs. Incidentally, the boiler may not be the cause of high fuel bills. The guilty party may be a piece of auxiliary equipment or a poor quality fuel.

Be sure your boiler room gets enough air to support combustion. Good ventilation is the answer to this one. Aside from meaning an air-starved boiler, poor ventilation boosts boiler-room temperature which can interfere with proper operation of magnetic controls and affect thermal devices which are designed to protect boiler from damage.

How to maintain your boiler

Though a packaged boiler requires a minimum expenditure of time and money for preventive maintenance, it does demand this minimum. The more automatic the boiler, the more it depends on (1) controls to operate properly (2) clean fire and waterside surfaces (3) attention to stack conditions. Your boiler manufacturer offers the last word in the important area of maintenance. His manuals, his salesmen and his local service people are your best sources. Don't "throw the book away" just because the unit seems to run itself. This mightn't make any difference for six months or a year but, sooner or later, it'll affect your boiler's efficiency. These pointers can mean better maintenance of your unit:

Be sure your employees get complete information from your boiler salesman and service people on preventive maintenance. Follow their recommendations to the letter.

Scaled waterside surfaces and tube leakage can quickly result from lack of attention to water-treatment needs. Dirty boiler water can cause surging, foaming and carryover—a real headache, especially where a manufacturing process demands dry quality steam. Get and follow the advice of a feedwater-treatment specialist. He can save you much difficulty.

Last, but not least, keep your boiler room clean. For example, dust clogging the fan intake cuts down on air supply, results in poor combustion efficiency. A clean boiler room is essential if you are to minimize maintenance.

"Green to green, red to red, perfect safety—go ahead," is a basic traffic law for ships; and it's also a good safety rule to remember when . . .

Handling your oxy-acetylene outfit

► THE OXY-ACETYLENE PROCESS is one of industry's most versatile tools for welding, cutting and heating. Efficiency and safety in its use go hand-in-hand with careful observation of precautions and safe practices. The "green to green, red to red" theme fits for two reasons: (1) The oxygen-pressure regulator and oxygen hose are always colored green and the acetylene-pressure regulator and acetylene hose are always colored red. The two should never be interchanged. (2) Oxygen and acetylene are different animals and require different handling. Consequently, if we think of "green" precautions when we're dealing with oxygen, and "red" precautions when we're handling acetylene we'll be on the safe side.

"Use no oil" is probably the most important thing to keep in mind when using oxygen. Never let oil or grease in any form come in contact with oxygen under high pressure because they may ignite violently. Every piece of equipment through which oxygen may pass (from cylinder to blowpipe) must be kept entirely free from oil and grease. Too, oily or greasy hands, gloves, clothing or other material must never be exposed to oxygen or air that's rich in oxygen. Even if your clothing is not oily, if it becomes saturated with oxygen, a tiny spark could turn you into a human torch.

Never use oxygen from a cylinder unless through a (green) *oxygen* pressure-reducing regulator. Regulator and oxygen cylinder valve outlet both have righthand thread connections. Don't connect your "green" hose to anything else. Don't use any pipe compounds, oil or grease for making connections, and *don't* force connections that do not fit. Use only hose and connections that are made especially for oxygen service.

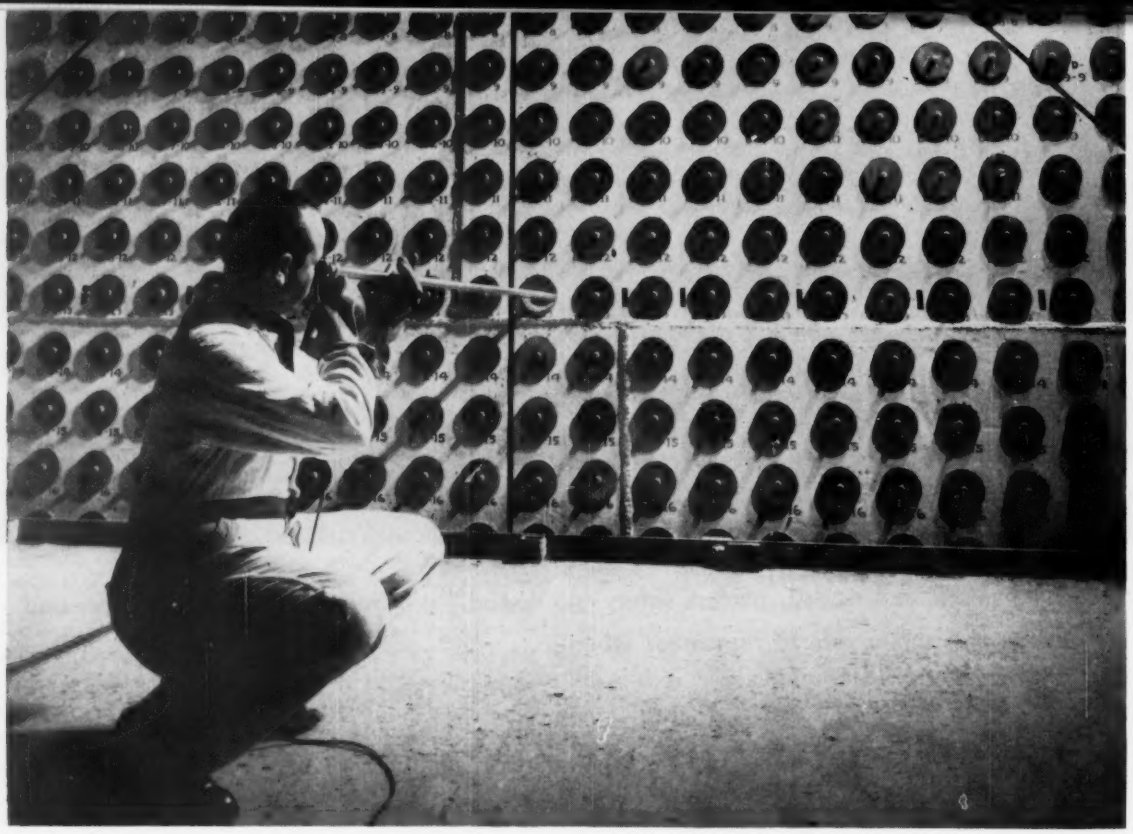
Always call oxygen by its proper name—"oxygen." It should never be called "air" nor confused with compressed air. Don't ever use oxygen in pneumatic tools, oil preheating burners, to start internal-combustion engines, blow out pipelines, "dust" clothing or workpiece, for pressure tests of any kind, or for ventilation. Don't store oxygen cylinders where oil or grease from overhead belts or cranes might fall on them. Oxygen, itself, will not burn, but it supports and accelerates combustion, hence causes oily materials to burn with great intensity.

Acetylene is a highly flammable and explosive gas and should be respected as such. But make a habit of calling it "acetylene" and not "gas." It's far different from city gas or furnace gas. Air and acetylene mixtures between 2.6 and 80% acetylene have been shown to be explosive if ignited. Under certain conditions acetylene may ignite at a temperature as low as 650 F. Never "crack" an acetylene cylinder valve nor release acetylene to the atmosphere near other welding or cutting work, or near sparks, flame or any other possible sources of ignition.

Never use acetylene from a cylinder except through a (red) *acetylene* pressure-reducing regulator. Acetylene regulator and cylinder valve outlets have lefthand thread connections. As with oxygen, only use hose and connections made especially for acetylene service. Again, don't use pipe dope, oil or grease for making up joints and don't force connections.

The oxy-acetylene flame itself is rarely the cause of a fire—probably because it's obvious that flame and combustible material should be kept away from each other. Big danger comes from the heat of the metal being welded or cut and from flying sparks. Another fire hazard lies in using acetylene hose that's leaking or in poor condition. Acetylene-hose rupture could produce a messy situation.

A deep respect for the oxy-acetylene outfit, backed up by firm knowledge on how to handle, use and store oxygen and acetylene, is your best bet for avoiding trouble. Rules and recommendations, based on the combined experience of oxy-acetylene equipment users and manufacturers, are available from the National Fire Protection Association, National Safety Council and International Acetylene Association. Other instructive literature can be had from your oxygen and acetylene supplier. It's all for one purpose—*your* safety.—*Courtesy Linde Air Products Co, a division of Union Carbide Corp*



ATOMIC APPLICATION permits technician using 15-ft long borescope to look inside reactor, read gages from a safe distance

Periscoping Industry for the "inside story"

Instrument resembling periscope lets you see into boiler tubes and other enclosed spaces without dismantling the equipment

► RECENTLY-DEVELOPED INSTRUMENT permits detailed inspection of enclosed areas in boilers, engines, atomic reactors, without dismantling the equipment. It can be used to look for damage, check arc root welds in pipe and read gages inside atomic reactors from a safe distance.

Known as a borescope, the instrument is essentially a periscope with a built-in flashlight. It comes in 3-ft sections that are screwed together as they are inserted. Thus, it can be run up boiler tubes, etc, even if work space is limited.

The borescope has a tiny incandescent lamp and objective lens at one end and an eyepiece with ocular lens and erecting prism at the other, sketch, top of facing page. Achromatic intermediate lenses are spaced through the tube. Also, wiring for the lamp runs through the tube.

A special lens system keeps all objects and areas in focus, regardless of their distance from the end of the instrument. Magnification varies inversely with the distance.

Lenses are coated and their curvatures checked within a few millionths of an inch to eliminate fuzziness, blur and halo effects. Areas and objects at the edges of the field of vision show up as brightly and sharply as those at the center.

Photo, bottom, right, facing page, gives a borescope view of the inside of a gouged engine. Instrument was inserted through the spark-plug opening.

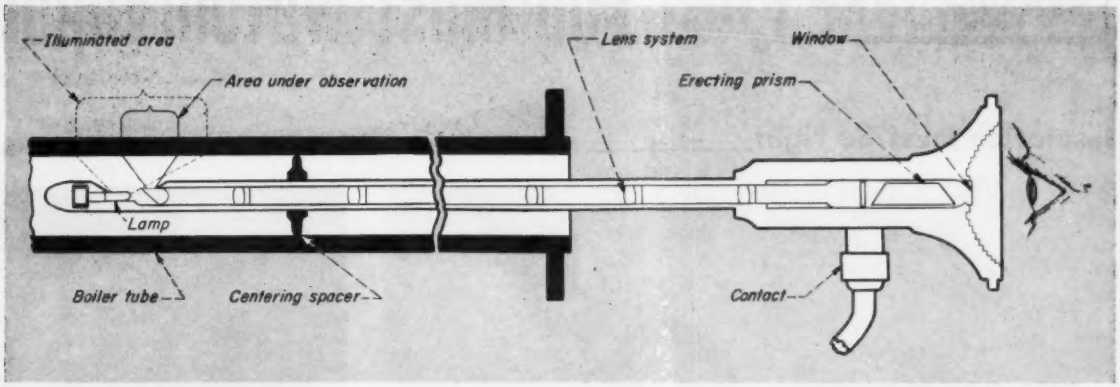
Unit can operate off house current, generators, storage batteries or dry cells. Degree of illumination is governed by an attached transformer and current controller.

Borescope parts are standardized, but each unit is assembled on a custom basis. Thus, degree of magnification can be varied to suit needs; straightforward, right angle, forward-oblique or retrograde vision can be provided. One model has an elbow in the tube; a leg containing the objective lens can be turned through 360 deg.

The instrument developed for inspecting boiler tubes is 15-ft long and has a 0.9-in. diameter. The smallest borescopes can pass through holes down to 0.1 in. diameter. These are used to inspect engine cylinders, gun barrels, etc. Cystoscopes, nasopharyngoscopes and hysteroscopes used by the medical profession work on similar principles.

—Courtesy, National Electric Instrument Co

Here's how new instrument works . . .

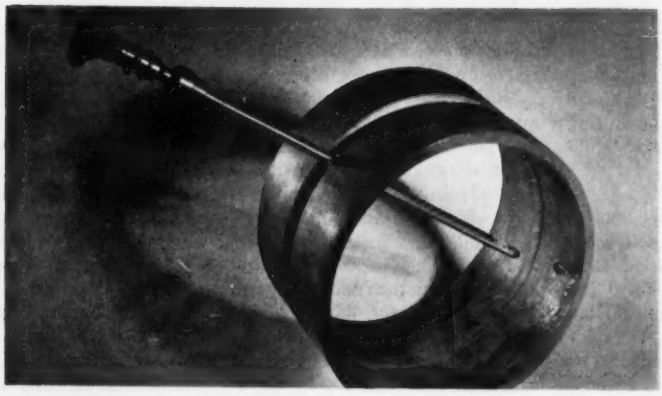


BORESCOPE works like a periscope with a built-in flashlight to illuminate area under inspection. Lenses are precision-made

and here are some typical applications . . .

3-FOOT SECTIONS of new instrument are screwed together at inspection site, thus permitting use in cramped quarters

INSPECTION of wall tube bottoms during boiler remodeling. Man *at left* controls amount of light from borescope's lamp



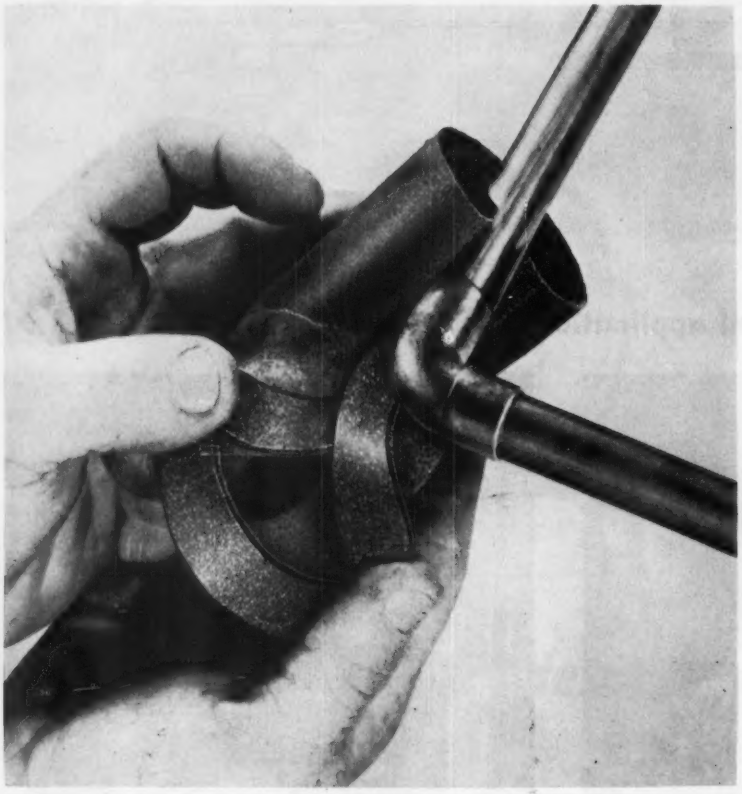
ARC ROOT WELDS in pipe can be inspected through a small hole before the final welding. This saves time and grief, especially for long pipelines

GOUGES inside engine show up clearly in borescope without dismantling equipment

OPERATORS' NOTEBOOK 112

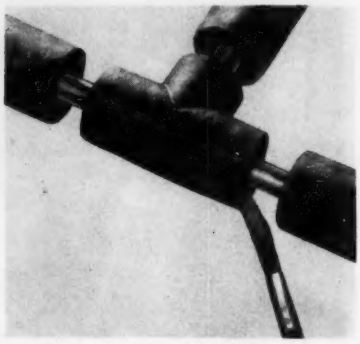
You must watch vapor

Insulation must be right



FOAMED-PLASTIC pipe covering snaps into place, saves valuable application time. Fitting covers can be made up easily with a few simple miter cuts as shown

1 Miter cut the two pieces in insulation and bond together to joint cover



4 Apply special adhesive to the edges of insulation for instant bonding

Here's what you must know about heating-cooling lines

EDITOR'S NOTE: *Because we have seen so much damage caused by improper use of dual-temperature insulation, we rounded up this information to save you money.*

► YOU CAN EXPECT TROUBLE if you don't insulate your dual-temperature lines properly. In year-round heating-cooling systems, water is carried to individual units at temperatures from 40 to 180 F. To prevent condensation on lines during cooling cycle, and to increase system's efficiency, all liquid lines must be insulated.

Preventing condensation. Most important reason for insulating is to prevent condensation. Condensation is caused by this one law of nature: warm air can hold more moisture than cool air. On contact with cold surfaces, warm air becomes cooled and gives up some of its moisture. Result is condensation, or sweating, that occurs on uninsulated cold-water lines.

When cold lines run above ceilings, in wall spaces, or even in basements, water dripping from them is not only annoying but damages structure, interior finish and woodwork. Condensation can be stopped by properly applying the right thickness of the right insulating material.

Insulation keeps water temperatures more uniform by reducing heat loss during the heating cycle and heat pick-up during the cooling cycle. This increases system's operating efficiency with greater comfort and lower costs.

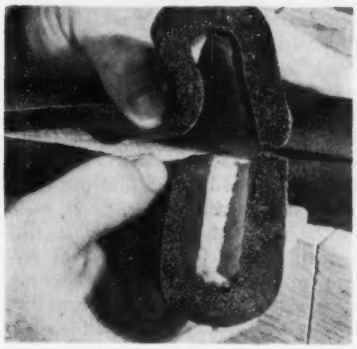
Vapor barrier. During cooling season, the insulating material is effective only if it remains dry. It requires an exterior surface that is a positive air and moisture barrier. When warm air penetrates the insulation, it becomes cooled as it approaches the cold pipe, gives up its moisture in the form of condensation inside the insulation. As condensation collects, efficiency decreases. Eventually the outer surface becomes so cool that condensation will occur there. The insulation then becomes worthless.

Flexible copper tubing is used extensively in heating-cooling systems. An insulating material with high flexibility to follow the bends in tubing without cutting and fitting will save time and money on the job. Insulation that is resilient and can be bent to allow applying it over tubing as it is installed, saves additional time and costs.

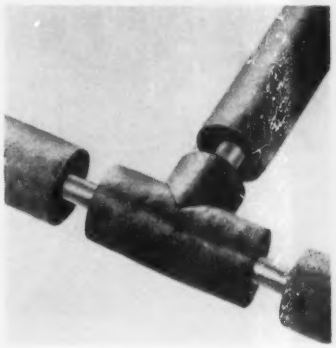
barrier on dual-temperature insulation

By **STEVE ELONKA**, *Associate Editor*

Screwed fittings



2 After adhesive dries, slit bonded covering assembly over joint and bond

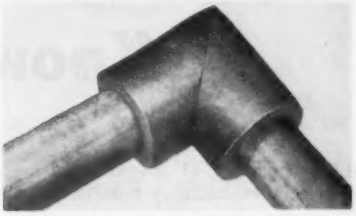


3 Pipe covering is shown over the tubing, ready for the final assembling

SCREWED FITTINGS are easily fitted with this insulation by overlapping

SLIT the completed cover and snap it into position over the elbow fitting

5 Completed job shows that sections have been tightly bonded together to form a vaporproof insulation for both hot and cold temperatures. Bond is important



EXTEND sleeve type covers over insulation at least one inch, then cement

Finally, insulation must have enough thermal efficiency to prevent condensation under normal conditions in heating-cooling systems.

Cellular foamed plastic is impervious to air and vapor penetration. In application, it needs no separate vapor barrier. You can cut joints accurately, then cement tightly for an air and moistureproof installation. Highly flexible, it follows curves of copper tubing without cutting or fitting. Full 6-ft lengths can be slipped on tubing as it is being installed, if job conditions permit. In the ½-in. thickness, it will prevent condensation indoors, under normal design conditions, on line and tubing operating as low as 32 F. During the heating cycle it will withstand 200 F.

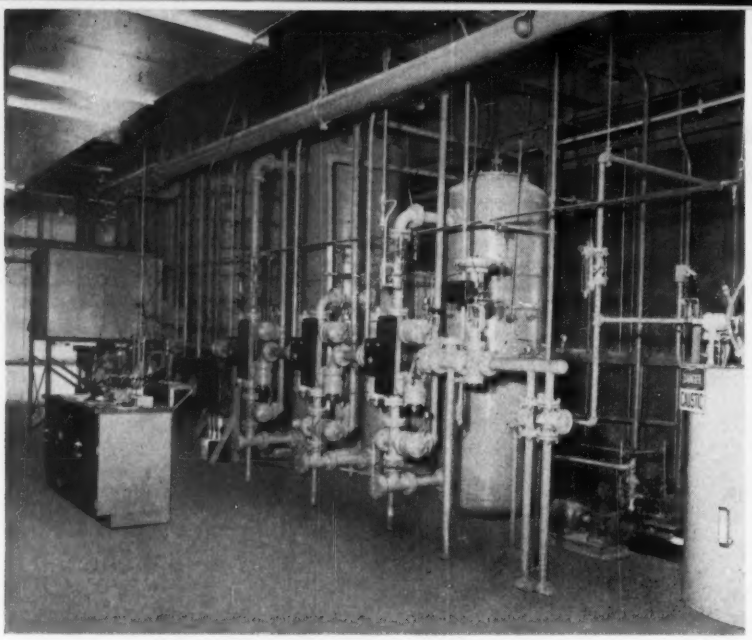
Only tools needed for installation are a sharp knife, miter box, serrated bread knife and ½-in. paint brush for applying the adhesive. Adhesive is the only other material required.

Cork coverings. Where pipe runs are straight and without a great many fittings, cork coverings may also be used economically. Another relatively new product group, these cork coverings come in three series: (1) Minus Thirty, for operating temperatures as low as –30 F; (2) Zero, for temperatures down to 0 F; and (3) Thirty, for temperatures ranging down to +30 F. Under normal design conditions indoors, these products will prevent condensation and will contribute effective insulation value to 200 F.

Cork coverings are made of segments of corkboard adhered to a flexible backing of asbestos paper and aluminum-foil laminate. The 36-in. lengths are wrapped around the pipe or copper tubing. Flap of backing material is bonded with adhesive, forms an oil- and water-resistant vapor seal. End joints are wrapped with sealing tape to complete the vapor seal.

Since the adhesive and tape are the only sundries needed, application is fast. Fitting covers are job fabricated by using mitered sections of the cork covering. No wiring, pointing or painting is needed. When lines are taken out of service, the cork covering may be salvaged and re-used. But whatever type of insulation you use, remember, for temperatures below ambient air, to establish a vapor seal.

—Courtesy, Armstrong Cork Co, Lancaster, Pa.



Demineralizer job has trouble with new resin

Plant, at left, includes two cation exchangers initially charged with acid-regenerated sulfonated coal. To step up capacity, coal was replaced with an equal volume of styrene-type cation resin. But existing regeneration equipment was not changed. The new resin received the same acid dose as the sulfonated coal that it replaced. Expected improvement in capacity did not come and water quality suffered. If resin properties had been carefully studied it would have been clear that the styrene resin needed new regenerating equipment with much greater capacity.

Improved ion exchangers often make it profitable to update water-treatment equipment. But in this area a little knowledge can be dangerous. For topnotch results you must . . .

By A C EMBSHOFF
Technical Advisor, Infilco Inc

Know all your ion-exchange

► DEVELOPMENT of ion-exchange material is an evolutionary process. Capabilities and characteristics have steadily improved. So it's often profitable for equipment users to replace older, less efficient ion exchangers with proven new materials. Sometimes it pays to make the change immediately. Usually it's best to wait until the older material needs replacement from normal usage. Then maximum use is made of your investment in existing ion-exchange material.

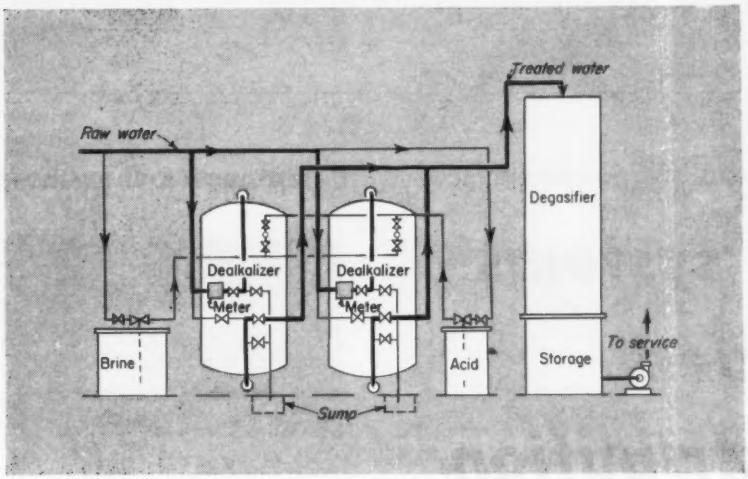
Builders of water-treating equipment are often confronted with problems involving exchange material replacement. There is a tendency in the field to oversimplify the problem. Some operating men believe that all you have to do is purchase a refill of new improved zeolite and put it in the exchanger tank. This often results in unsatisfactory performance. And, when the plant doesn't perform as expected, the equipment builder is finally consulted. He may even be put on the spot to get the equipment in good working order again. In most cases, exchanger replacement is dictated by what appears to be good economy. But unless the move is carefully considered it can be very poor economy in the long run.

When changing materials it is important to thoroughly understand the characteristics of the new mineral. Compare it with the old zeolite, taking careful note of any differences. Chart, p 123, gives a rundown on operating characteristics of today's cation-exchange materials. Keep in mind that your equipment is designed to operate most efficiently with one particular kind of zeolite. If you change this material, it will be a rare case when modifications of some kind are not required. This may mean new internal distributors and larger regenerating equipment. In every case, equipment design must be considered to get full benefit from a switch of ion exchangers.

Salt-regenerated ion-exchange materials for softening, range in capacity from 2500 to 30,000 gr per cu ft; acid, 7000 to 24,000 per cu ft. For zeolite softener service, it's clear that polystyrene resin needs eight to ten times more salt per cu ft than greensand. For acid regeneration, polystyrene resin requires two or three times more acid per cu ft than sulfonated coal. Since chemical needs are greater you may question the wisdom of installing newer material. Actually, regenerant consumption in terms of pounds per thousand gallons of water treated is often less than the replaced older zeolite. This fact, along with its higher capacity, are the two main reasons for the increased use of polystyrene resin in today's ion-exchange systems.

Demineralizer job, photo, above, provides low solids, silica-free water for high-pressure boilers. Each cation unit was initially charged with sulfonated coal. Regeneration called for 85 lb of 66°Bé sulfuric acid diluted and applied at about 2% concentration. After four years of continuous operation the coal was replaced with polystyrene resin to step up capacity between regenerations. But the new material needs 185 to 210 lb of sulfuric acid. And for top capacity without deposits in the resin bed the acid must be applied in successively increasing concentrations. Existing acid-handling facilities are not large enough or suited for these new requirements. So performance with the new resin is not up to par. This plant will not get

Another installation where cation-resin replacement was not the whole answer



Two-unit exchanger, at left, was charged with special sulfonated coal for reducing alkalinity and removing hardness. It used dual-regeneration, calling for both salt and acid. But these exchangers were refilled with styrene-type resin. While this material gives high capacity on either salt or acid it is not suited for dual-regeneration. So salt only had to be used. Soft water is now produced but the alkalinity is still high. And salt-regenerating equipment is too small to realize full softening capacity of the styrene-type resin used for the refill.

materials

full benefits from the investment in new resin until regenerating equipment is modified and the automatic operating-cycle altered. Conversions handled like this are costly.

Dealkalizer job, above, is another example of hasty ion-exchanger replacement. The equipment was originally charged with a special sulfonated coal capable of reducing alkalinity as well as removing hardness. Then polystyrene resin was purchased to replace the sulfonated coal. This is superior in many respects on either the acid or salt cycles, but it is not well-suited for dual-regeneration. So there wasn't any choice but to operate the new material on the salt cycle only. The treated water is soft although the advantage of alkalinity reduction is gone. And the polystyrene resin is not even used at full softening capacity because the regenerating equipment is too small.

The special sulfonated coal consumed about 180 lb of salt. This is entirely inadequate for a new resin calling for 480 lb of salt. New regenerating equipment will remedy this situation. But the installation will not function as a dealkalizer unless other equipment, such as an acid feed or hydrogen exchanger with blending controls, are added to the job.

Other cases can be cited to show what happens when a material of merit like polystyrene resin is used without full knowledge of all the factors involved. It pays to know your ion-exchange materials thoroughly. Always discuss proposed changes with your consultant and original equipment builder. They are in the best position to advise what modifications are necessary to successfully update your softening or other ion-exchange equipment.

Characteristics of today's cation-exchange materials

Type of material	Regenerate with	Use	Capacity gr per cu ft	Regenerant lb/kgr	Recommended range pH	Recommended range temperature
Silicious base						
Processed greensand	salt	softening	2500-3000	0.35-0.50	6.0-8.4	up to 135 F
High capacity greensand	salt	softening	5000-5500	0.35-0.50	6.5-8.1	up to 110 F
Synthetic gel types	salt	softening	7500-10,000	0.33-0.50	6.8-8.2	up to 100 F
Organic						
Sulfonated coal	salt	softening	6000-7000	0.45	5.0-10.0	up to 135 F
Sulfonated coal	acid	hydrogen exchange	7000-8000	0.25	up to 4.0	up to 100 F
Special sulfonated coal	salt, acid	softening & alkalinity reduction	6000-8000	0.45 salt 0.25 acid	5.0-10.0	up to 100 F
Polystyrene resin	salt	softening	20,000-30,000	0.25-0.50	5.0-11.0	up to 250 F
Polystyrene resin	acid	hydrogen exchange	10,000-24,000	0.30-0.50	up to 4.0	up to 120 F

Tankless systems give efficient water distribution

Flat curve pumps provide close approach to ideal system without use of storage tanks

By R G SCHLETTY, *Automatic Control Co*

Pump curves show how

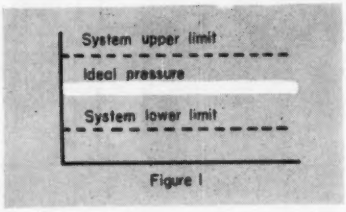


Figure 1

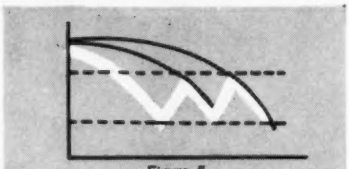


Figure 5

► IN ANY PLANT water-distribution system, demand (flow) stays constant only a short time, then begins to rise or fall. But, regardless of demand, there must always be enough pressure to push ample water to each user and, ideally, for pressure to remain constant. However, because of pump curves, system friction and other variables, this must continue to be an ideal.

The tankless or "closed" system gives great flexibility and most nearly approaches the ideal provided the right pump choice is made. Just any pump won't do; nor should selection be made on pump *rating*. This tells little about the pump's characteristics because such flows are given at only one point on the pump curve—where efficiency is greatest.

Determining factor is the pump's pressure flow curve. The flat-curve pump is best for the tankless system because it gives a wide flow range (gal) for a small change in pressure (head). A properly controlled system should have a relatively small pressure change for a comparatively large flow sweep. Fig. 1 shows how closely the ideal can be approached by the upper and lower pressure limits in a tankless system. Flatter the pump curves, closer these limits can be and nearer the ideal they'll come.

Running one pump in a tankless system would be a waste of power, efficiency and pump. So, instead of running one large pump continuously, we get topnotch performance by using two or more smaller pumps that cut in and out automatically as demand varies. During low-demand periods, one pump will operate at near-peak efficiency. As demand goes above this minimum, more pumps cut in—each one operating close to its peak-efficiency rating. In addition to holding pump wear to a minimum, this keeps power consumption low.

Tankless systems are of two types: sequence and programmed. Sequence system pumps are all the same size. As demand increases, additional pumps cut in one at a time until all are running. Programmed operation — more complex—has different-size pumps. As demand rises, some pumps cut in, others cut out—in definite steps—until maximum flow is reached. We're concerned only with sequence systems in this discussion.

The lead pump in a sequence system runs all the time provided there's no other source of pressure. Its selection is based on the minimum system demand. Obviously, it would be a waste of pump and power to run a 1000-gal pump as lead with a minimum system demand of only 100 gal.

Some water is being drawn at any given time in nearly every tankless system. In the unlikely event of zero demand, a by-pass recirculates water from pump discharge to suction, Fig. 3. This protects the pump from overheating, cavitation or other possible damage. (Actually, the by-pass valve

good control gives small pressure change for large flow sweep

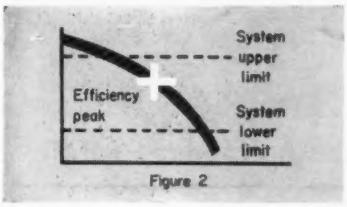


Figure 2

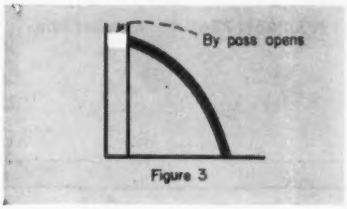


Figure 3

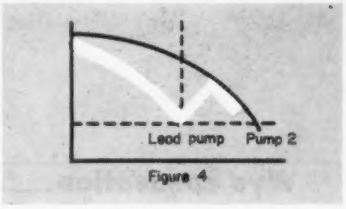


Figure 4

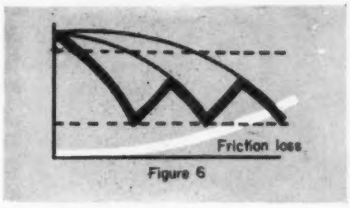


Figure 6

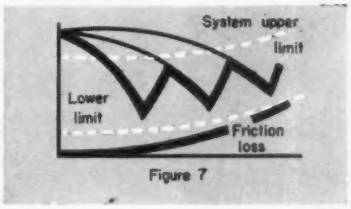


Figure 7

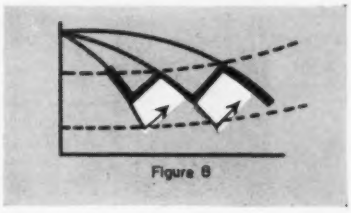


Figure 8

is pressure-operated—but pressure is a function of demand.)

As demand increases, system pressure drops along the lead pump curve. At the low-pressure limit, the second pump automatically cuts in, Fig. 4. Note that the changeover line between the first and second pumps doesn't go straight up, but on a curve. Reason: As pressure rises, more water is forced out of any (and every) discharge outlet. Example: Suppose we have water at 60 psi flowing through a 1-in. nozzle. The nozzle will discharge 231 gpm. If we boost pressure to 80 psi, we get 267 gpm from that 1-in. nozzle. The same is true in a tankless system. As pressure rises when an additional pump cuts in, more water is forced through the system outlets. Because flow has increased, the transfer point to the second pump moves further along the flow axis.

With both pumps running, and demand continuing to rise, pressure rides down the second curve, Fig. 4. When the pressure drops to the low system limit, the third pump starts, Fig. 5. Additional pumps continue to cut in until flow balances demand, always within pressure limits of the system.

Friction loss grows as more and more pumps cut in, Fig. 6. This loss depends on diameter and length of pipe, amount of water flowing through it. At any given orifice, pipe diameter and length are constant, but flow is not. Doubling the amount of water flowing through a system approximately quadruples the friction loss. In effect, friction loss means less pressure which is translated into less flow at point of use. Power expended in overcoming friction means less power to push the fluid.

At high flow rates, friction loss rises sharply. To keep pressure constant at any point in the system, the lower system limits ride up to compensate for the greater friction loss, Fig. 7. Limits are raised toward the right end of the graph (maximum demand conditions). In practice, this will curve in extreme emergency when all pumps are running. Assuming constant water supply, this is a distinct advantage. As more and more water is needed, the pressure goes up, Fig. 8—a decided contrast to many systems.

As demand drops off, pressure moves back upward on the pump curves. The controls sense this higher pressure and cut out pumps until, at some flow, the pressure stays within the system's high and low limits.

Note that the reduced flow moves up the curve to the system's high level, then slants backward to intercept the next pump curve. And note the overlap between the transfers on upward and downward trends (shaded areas). This is essential in a tankless system to prevent the pumps from "hunting."

ED. NOTE: *This is the first of two articles on water-distribution systems. Next month Mr Schletty discusses proper use of pressure tanks and their development from "surge" tanks.*

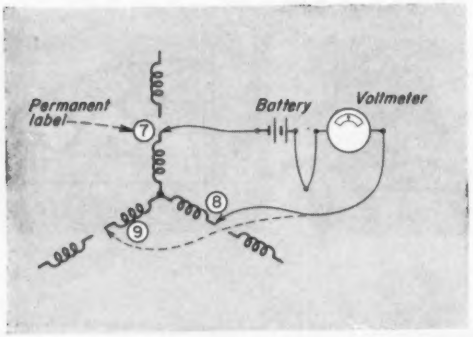
Plant Electrical Fact File

NO. 18: DUAL-VOLTAGE MOTORS

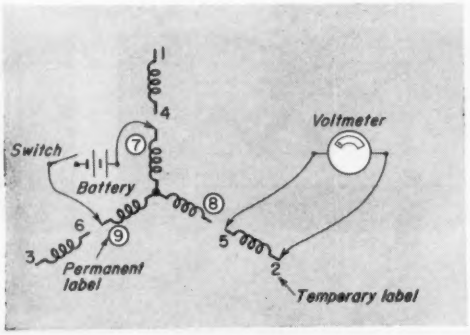
How to connect dual-voltage 3-phase motors

By NORMAN PEACH, *Assistant Editor*

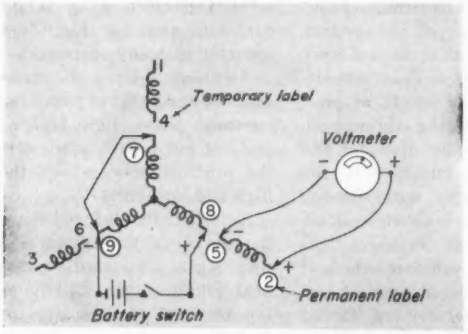
Wye connection



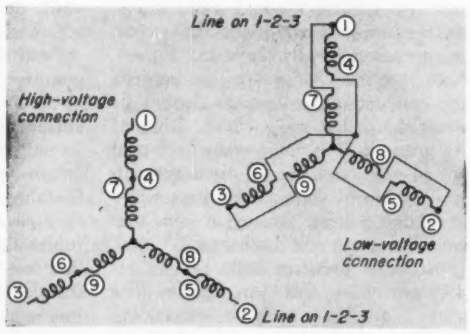
1 DETERMINE WYE connection by testing for continuity between the nine leads. If three leads have continuity and all the others make up pairs, the winding is wye-connected. Permanently label the wye leads 7, 8, 9, in any order. The next step is to find out which of the remaining three pairs of leads go with each of the wye legs, and to connect them with proper polarity so as not to cancel out.



2 MATCH PAIRS with wye legs. Connect battery and switch between two wye legs, and snap switch on and off to produce inductive kick in windings. At same time, connect voltmeter to successive pairs. No voltage will be induced in the pair that matches third wye leg, but will show on meter for other legs. Temporarily label matched pair. Shift battery, switch to another two legs and repeat the test.

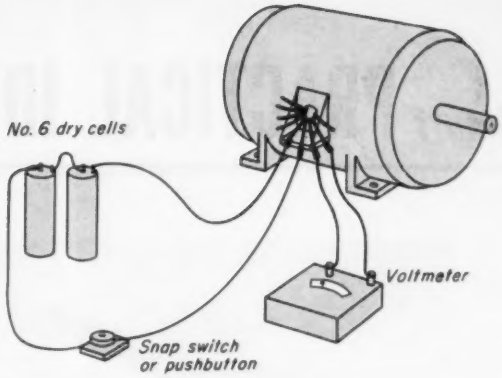


3 FIND POLARITY of pairs. Connect battery, switch and jumper as shown, carefully noting polarity. Mark polarity of voltmeter leads. Voltmeter should read upscale when switch is *closed;* if not, reverse voltmeter leads across pair. Positive voltmeter lead is then on motor line lead. If temporary labels were wrong, change and label permanently. Repeat procedure with remaining pairs of leads.

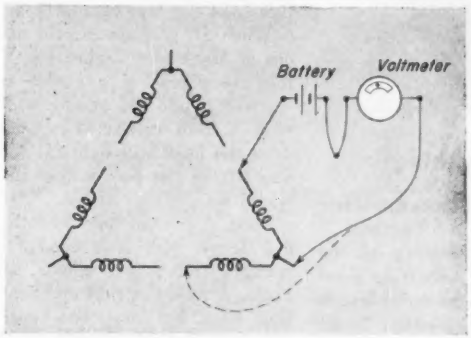


4 CORRECT LABELS on all leads make it easy to reconnect motor for desired voltage. Numbers are according to NEMA standard terminal markings, T_1, T_2, T_3, etc. Nominal voltages are usually 220/440 and 230/460; actual voltages in many plants are 208/440. Connections shown apply to single-speed motors. Multispeed windings were described in "Plant Electrical Fact File," No. 15.

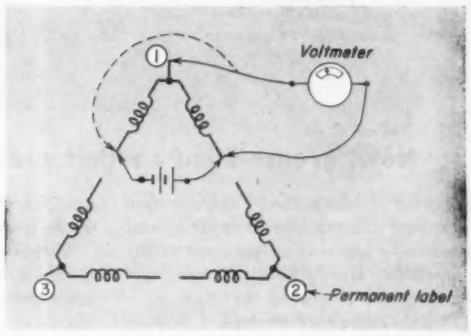
► OCCASIONALLY you'll be stuck with the job of connecting a dual-voltage motor that doesn't have any labels on the nine leads. There are several ways to go about finding how the leads should be numbered. Method described below is probably the simplest one that's suitable for any size motor, wye- or delta-connected. Number of dry cells can be increased if necessary.



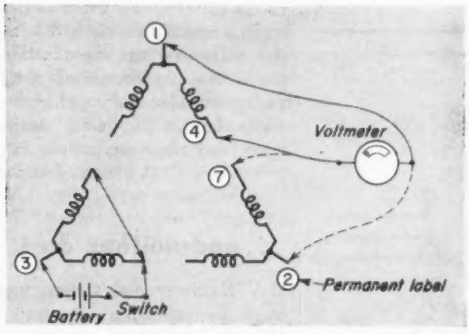
Delta connection



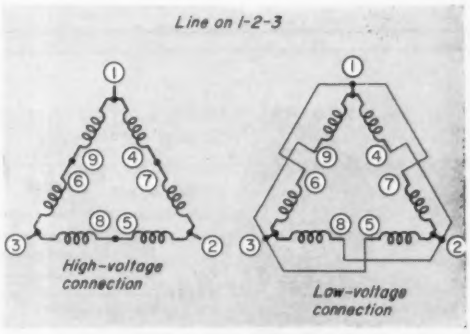
1 **DETERMINE DELTA** connection by testing for continuity between the nine leads. If the leads show continuity in groups of three, the winding is delta-connected. Each of the three groups of three leads consists of two equal parts of the winding with a lead brought out from their junction. The next step is to find out which of the three leads in each group is the one connected to the center point.



2 **FIND CENTER LEADS** (corner of delta). Connect battery between two leads of group. Connect voltmeter first across these points, and then between one of them and third lead. By trial and error, find position for battery where voltage drop from terminal to third lead is half drop across battery. When this condition exists, the third lead is corner of delta. Label it 1, 2 or 3 as indicated above.

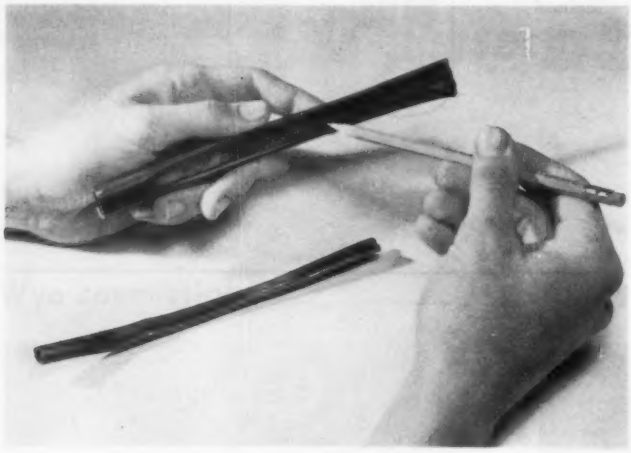


3 **IDENTIFY LEADS** at ends of groups. Parallel the halves of one group by joining ends at one battery terminal while the line lead is connected to other end of battery and switch combination. Check voltage induced between leads of other groups. There'll be no voltage in coils opposite energized group. Label their end leads according to diagram. Repeat this procedure with next group.



4 **CORRECT LABELS** now on leads follow NEMA standard markings for dual-voltage delta windings: T_1, T_2, T_3, etc. Note that a polarity check is not needed to determine proper markings of leads with a delta winding. In all tests, sufficient indication on the voltmeter should be obtained to be certain of results. If necessary, use more batteries. Be sure connections have low contact resistance.

Smart PRACTICAL IDEAS to help you speed up your



Now, grease-filled conduit prevents crushing

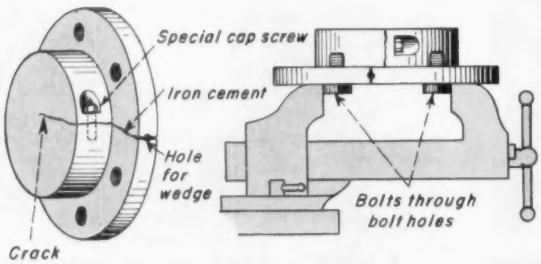
Collapsed underground refrigeration lines were causing loss of capacity and abnormally low suction pressure at the compressor. Here's what happened and what we did to correct it.

Photo, above, of collapsed copper tubing demonstrates the destructive force of uncontrolled freezing of water in an enclosed space. Gradual falling-off of refrigeration capacity in a small plant called for an investigation. Suction and liquid refrigerant lines were buried in conduit beneath the floor. A little headwork revealed that condensation on the suction line had filled the conduits with water. At times this water would freeze.

Alternate freezing, thawing as the system cycled, created recurring pressures from expansion. So entire length of tubing was crushed. Smaller liquid line was forced into the suction line as if a die and press were used. Resulting pressure collapsed both lines.

Since lines must remain below grade, we installed new conduits and tubing. But we filled conduit with hot grease to exclude air and condensation. Now there is no more crushing trouble.

E F WEHLAGE, *Fairport, N. Y.*



We repaired cracked cylinder head of our steam engine

Our engine's h-p cylinder head cracked half way through in 1906 when cast iron wasn't welded. We couldn't get a new head, so I had to do something. First I removed head and boiled it out in caustic soda to remove cylinder oil from crack.

Next, a hole was drilled at an angle on inside of head for cap screw to hold crack together, sketch. This hole was counter bored large enough for a socket wrench to fit over cap screw. After drilling and tapping for screw threads, tiny hole was drilled into cracked rim of casting for tapered pin. Then wedge was driven in just enough to open the crack slightly.

I brushed powered iron cement (Smooth-on) into crack and removed the pin. Then crack was wetted to turn iron cement into a paste. I placed two bolts into bolt-holes nearest crack and tightened vise jaws against them, sketch.

When all possible cement had oozed out of crack after tightening, I heated the cap screw to a cherry red and screwed it into the casting with socket wrench. Bolt contracted on cooling and drew the head still tighter. Then head was left in vise for an hour so cement would set.

Next, I puttied hole smooth around cap screw with iron cement so you couldn't tell that a repair had been made. I stayed at that plant for a long time after, but there was never a sign of a leak from that crack.

S W BLAKE, *New York City*

I don't agree...

Looks as though C J Werderitch, POWER, March, p 136, will get a good dose of raw backwash and rinse water in his softened water line unless he installs a stop valve. He will have to close the valve during regeneration operations. As his sketch of system with multiport valve shows, shutoff softened water line is automatic during backwash and rinse operation.

T A SMITH, *Pittsburgh, Pa.*

...and neither do I

D V Haraway didn't need matches to start the pulverizer, POWER, April, p 131. He could have used the foil from a cigarette package to make a fuse link that would blow and start a good blaze. It would short across the switch points or burn in a socket. A small strip of foil will make a quick blaze; a roll of it will serve as a fuse in a low-capacity circuit. Comes in mighty handy at times.

C G HOWARTER, *Canton, Ill.*

operation and maintenance jobs

STEVE ELONKA, *Associate Editor*

Here's my answer...

H M Neuhaus had four 2-stage gas compressors discharging into a 30-in. header at 300 psi, POWER, June 1957, p 131. Although the engines had governors, the machines did not operate at the same speed of 265 rpm. So excessive gas pulsations occurred in the discharge piping, causing vibration and noise. This part of the system was supported on saddles, having one anchor on an 800-ft U-bend. Movement of the latter attained $\frac{5}{8}$ in. Neuhaus installed two more anchors and several guides; which reduced amplitude to $\frac{1}{8}$ in.

He solved his problem by limiting pipe movement. But, unless anchors are correctly located to permit longitudinal and transverse movement of the piping between fixed points, fatigue stresses may develop. These occur at highly stressed places, such as bends and offsets, which can cause failure.

Since vibrations were from gas pulsations, I'd have installed dampeners or snubbers. These reduce pulse forces, thereby limiting vibratory effects. But you must know the compressor's rotative and piston speeds, bore and stroke, engine-compressor weight and dimensions, pipe size and geometry.

H B WAYNE, *Woodhaven, N. Y.*

...and here's mine

Instead of putting in solid anchors to stop the vibration problem that confronted H M Neuhaus, POWER, June 1957, p 131, I would have designed an intake and discharge system to damp the pulsated resonant condition. I'd have to know the volume and condition of the gas, plant layout, size of intake, exhaust headers and bottles, critical dimensions and a few other details.

R E TURLEY, *Salt Lake City, Utah*

Do you know...

if your cooling tower needs automatic sprinklers? Answer is yes, if it's induced-draft type, made of wood, roofed over fans and their supporting structure is on the roof. No, if it's forced-draft type, has no roof and fans are at base to force air up through the tower.—*Courtesy, Associated Factory Mutual Fire Insurance Companies*

What would you have done?

I received an urgent call from one of our chain stores in a nearby suburb. They wanted their air-conditioning system started—and fast. All necessary equipment—Freon, compressor oil, oil pump, air filters—were supposed to be in their machinery room.

Checking the system, I found the crankcase level was very low. I also found that they had no oil pump for filling the compressor.

My problem was to get oil into the crankcase. I phoned various local firms for an oil pump, but no luck. The store manager squelched any ideas I had of returning to the city for a pump because it was hot and he wanted the store cooled pronto.

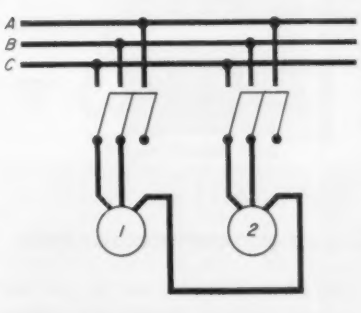
I wondered what Marmaduke Surfaceblow would do in this spot? After a minute I got an inspiration. I took an empty 145-lb Freon drum, turned it upside down and removed the fusible plug in its bottom. Then I got a funnel and filled it about one-third full of Freon oil.

I hooked a $\frac{3}{8}$-in. line into the fusible plug connection and ran the line's other end into the compressor's oil-fill line. I stood the drum containing oil right-side up and hooked its valve to a full bottle of Freon that I had placed in the sun. After the hot sun had warmed the full bottle, I opened the two valves on both drums. The drum containing hot Freon forced the oil out of the bottom of the second drum and into the compressor.

The store manager thought I was quite a clever guy and was well-pleased that his store was cooled so fast. What would *you* have done?

C BACHMANN, *Kew Gardens, N. Y.*

Starting pump with 3-phase leg out



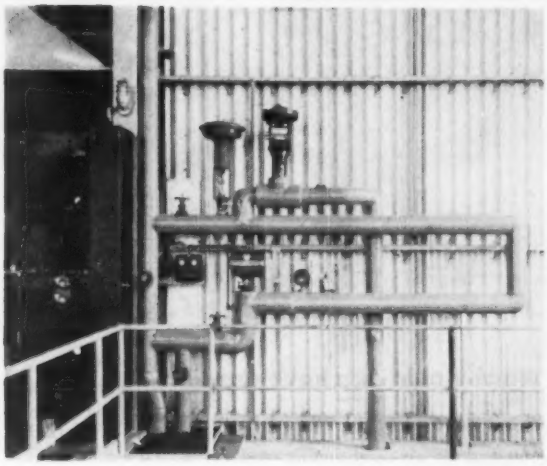
In an emergency one of our 3-phase legs failed. So we had to get a critical pump or compressor running with *C* phase out, but *A* and *B* energized. To solve our problem, we selected the nearest motor with the same rating and ran a temporary lead to the needed motor, diagram, left. To start, we rotated the shaft of No. 1 motor by hand and closed No. 2 switch. This gave No. 2 motor a self start. If you run into a similar problem, remember this important point: Don't load No. 1 motor.

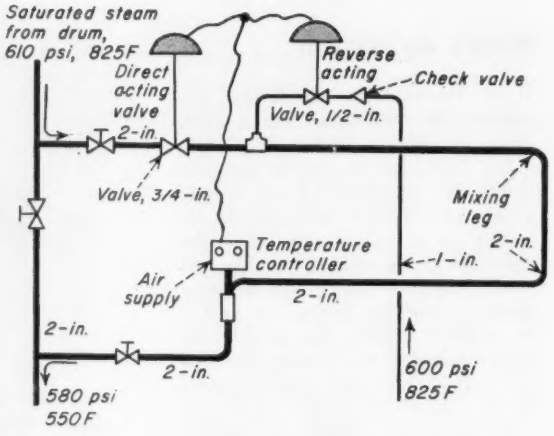
T E MOYER, *Longview, Wash.*

Turn page for more Practical Ideas ►

More PRACTICAL IDEAS

Begins on page 128





This steam conditioner saves our valves, is completely automatic

We have a small desuperheating station in which saturated steam rather than water is used for desuperheating. Oil-fired boiler steam conditions are 610 psi at 825 F. Boiler rating is 130,000 lb per hr. Up to 3000 lb per hr of 200 psig steam are used for fuel-oil heating and atomizing steam for the oil burners. Steam of 610 psi at 825 F from boiler outlet has a temperature of 795 F when throttled to 200 psi; too hot for oil heaters, brass valves, hoses, and other accessories.

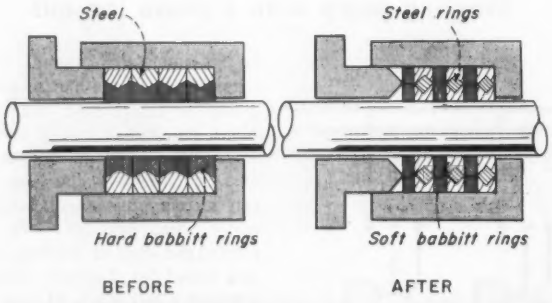
Problem. Boiler was installed with burner and oil-heater lines connected to steam drum. Stellite-faced pressure-reducing valve had to be rebuilt three times during first 18 months of operation. One 1500-psi by-pass valve had to be replaced in the same period. Wet steam was cutting these valves. We had to get some slightly superheated steam —superheated enough to insure dry steam to pressure-reducing valve, but not too hot for oil-burner and oil-heater service.

Solution. To get our slightly superheated steam we mix saturated steam from the drum and superheated steam from the boiler outlet. Ratio is about two parts saturated steam to one part superheated.

Sizing here calls for a ¾-in. valve in the saturated line and a ½-in. valve in the superheated line, sketch. Both valves are air-operated diaphragm motor valves. One valve is direct acting, the other reverse acting. Both diaphragms are connected to the same temperature controller so when one valve closes the other opens. Valves are for mixing only, and not pressure reducing.

Downstream pressure is about 580 psig under normal load. Temperature controller is set to maintain 550 F at this pressure. Temperature of this steam when throttled to 200 psi is 470 F. This temperature is OK for burner and oil-heater service.

R G Crosby, *Gainesville, Fla.*



We stopped rust from chewing up our compressor rods

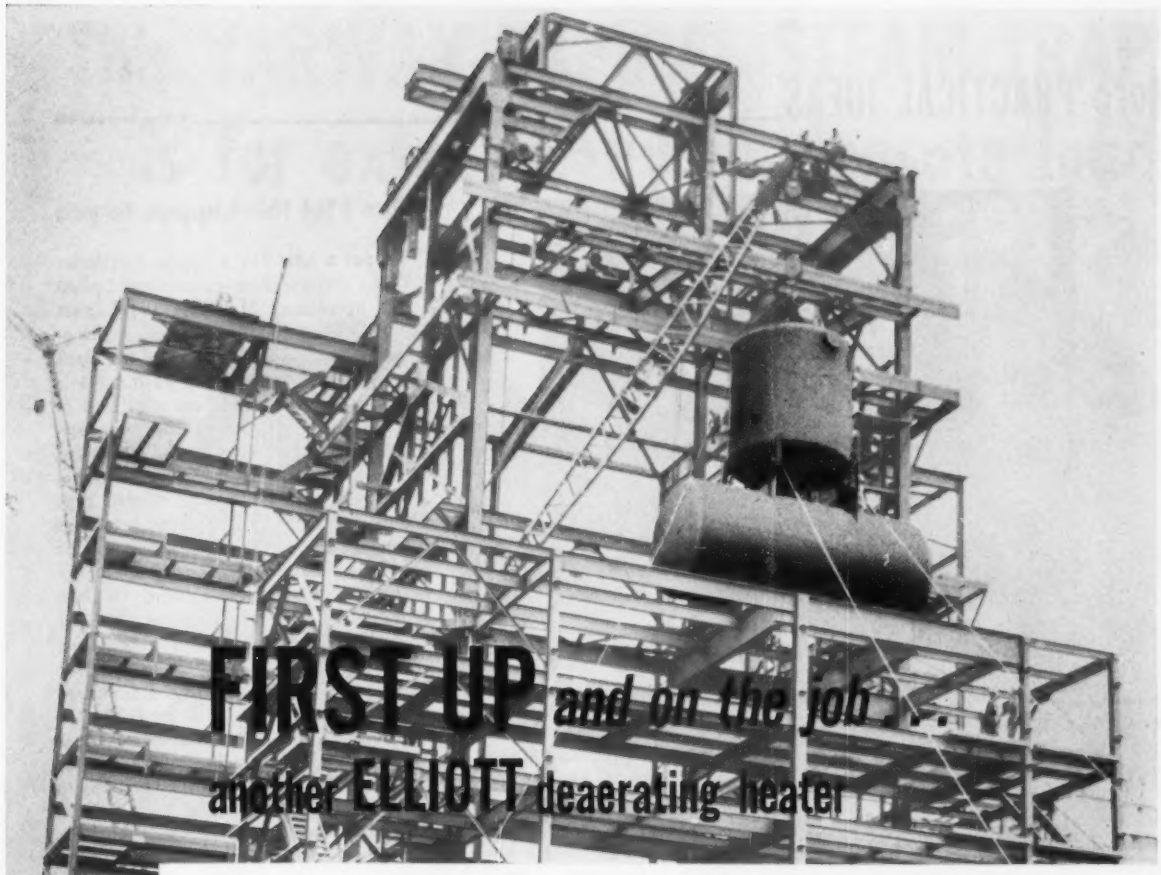
Years ago I took over an old carbon-dioxide refrigeration plant that had been laid up for a long time. We didn't have time to clean the rust out of the system so the metallic packing and rods took a beating. I solved the problem by replacing the hard babbitt packing with soft babbitt, sketch left. I kept the cold-storage rooms at needed temperatures with this new packing design until we had time to shut down.

P D Hobson, *Concord, Calif.*

Do you know...

what causes water hammer in steam lines? What damage it can do to piping and to plant machinery? *Plant Operators' Manual*, McGraw-Hill Book Co, shows you exactly what happens. Over 1500 illustrations let you see what the author is talking about.

Turn page for more Practical Ideas ▶



FIRST UP *and on the job . . .*

another ELLIOTT deaerating heater

to protect water and steam-handling equipment from corrosion!

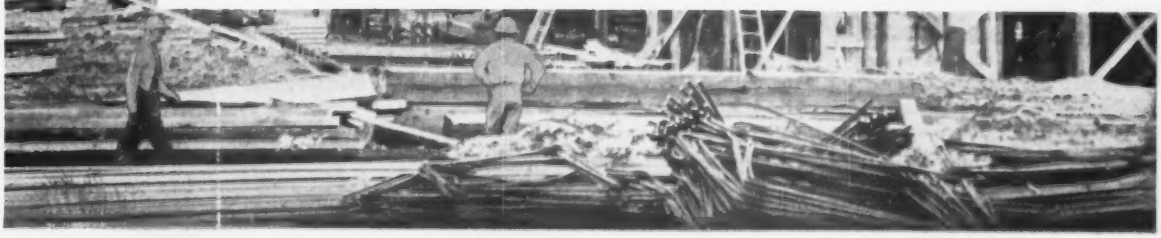
Practically everytime a power plant goes up, another deaerating heater goes to work. In this new utility boilerhouse, an Elliott 800,000 lb-per-hr deaerating feedwater heater was hoisted up as soon as the steel framework was completed. Since then it has been operating day and night—protecting boiler tubes, piping, pumps and other equipment from corrosion by the removal of oxygen from the boiler feedwater.

Elliott has pioneered in the deaeration of water since 1918 and subsequently has built heaters from the smallest sizes up to units with a capacity of 2,500,000 lb per hr which serve power plants all over the country. In each case they were engineered to individual service requirements and space limitations. For complete details, write Elliott Company, Jeannette, Pa.

Cutaway section of small Elliott tray-type deaerating feedwater heater

ELLIOTT Company

N7-1



More PRACTICAL IDEAS

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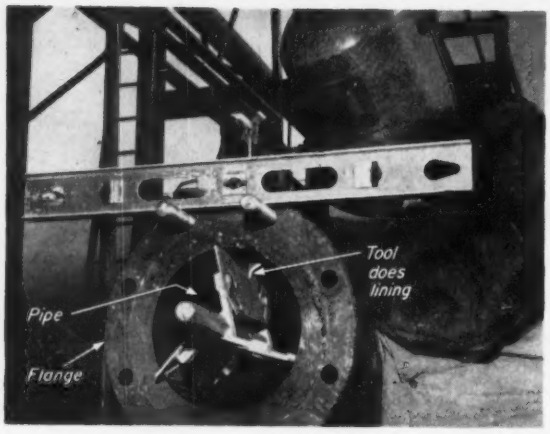
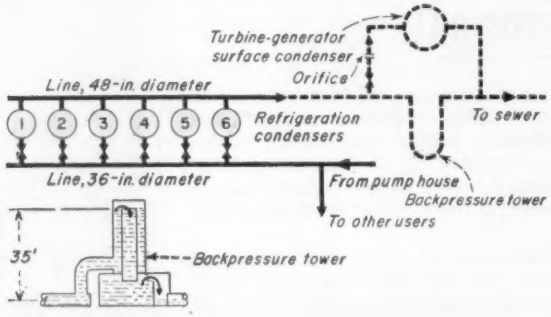


New tool lines up neck flange, saves one man

Lining up pipe and neck flange ID before welding has always been a problem. Now this new clamp does three things: (1) lines up pipe and flange ID (2) supports flange so cap and bolt holes can be set (3) maintains flange position if delay occurs between line-up and spot-welding.

Insert the tool into pipe and place flange or stud-end on projecting end. Few turns of the mandrel brings blades into contact with pipe and fittings ID. The 3-blade design assures positive line-up of internal surfaces.

This tool can also be used as a centering device when grinding a bevel on alloy tubing. — *Courtesy, Line-O-Tool Co, Houston, Texas.*



Water shortage problem? Not any more

We installed a new 6000-kw turbine-generator. But it created a problem as we didn't have enough water for one surface condenser. Instead of increasing capacity of our present pump house, we got idea of using cooling water after it was discharged from refrigeration condensers. Water pressure at this part of system was more than we needed for the added loss of pressure from surface condenser and condenser piping. Problem was solved by changing our piping system, sketch. Solid lines show system before changes, dotted lines show changes. Inlet-water to the ice-machine condensers is 50 psi, with outlet going to sewer. Water temperature leaving the refrigeration condensers is 100 F. Turbine-generator condenser is sized for using 100-F inlet water.

Adding a backpressure tower created a pressure head on the outlet side of refrigeration condensers. This forced water through the turbine-generator surface condenser. Generator-condenser outlet goes to sewer. Water flow through condenser is controlled by valve. Excess water overflows down inside section of the backpressure tower.

D W Antonacci, *Pensacola, Fla.*

Don't let this happen to you

We put a new 7½ x 7½-in. 4-cylinder VSA refrigeration-compressor plant into operation. Machines were direct connected to 100-hp 327-rpm synchronous motors. Two of us manned the plant —each working a 12-hr shift. While working the 7-pm to 7-am stint, one of the compressors scored the cylinders. It was the third time it had happened that week. I tore the machine down, removed the pistons and stuffed rags into suction parts to prevent grindings from getting back into machine.

We finally finished honing the cylinders about 1 pm. I went home to clean up and catch a little shut-eye while the construction crew reassembled machine.

While enjoying my bath a horrible thought occurred to me. I splashed water all over the place in getting to the phone to tell them not to start that machine. But they had worked faster than my mind. They'd already tried to start the machine on the by-pass, with by-pass screen removed.

No real damage was done, but I spent most of my next 12-hr shift disassembling and reassembling that compressor, digging rags out of suction and discharge valves and cussing the thickheadedness of anyone who would reassemble a machine with the suction parts stuffed full of rags. Don't you ever do it! Take a lesson from me.

Q Minich, *Jersey City, N. J.*

Do you know . . .

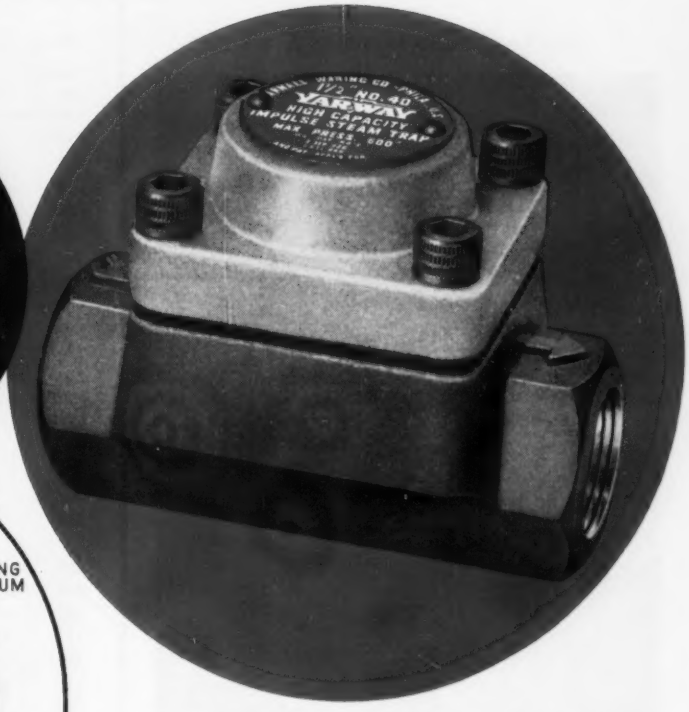
it costs your firm $1.50 to write one letter? That includes cost of stenographer, office, etc. And it cost $6200 a year to create the contents of a 4-drawer filing system. So what? You can help cut down on paper work by going through your engineering files. Throw out all needless records and keep your correspondence to a minimum.— *Courtesy, National Management Records Council*

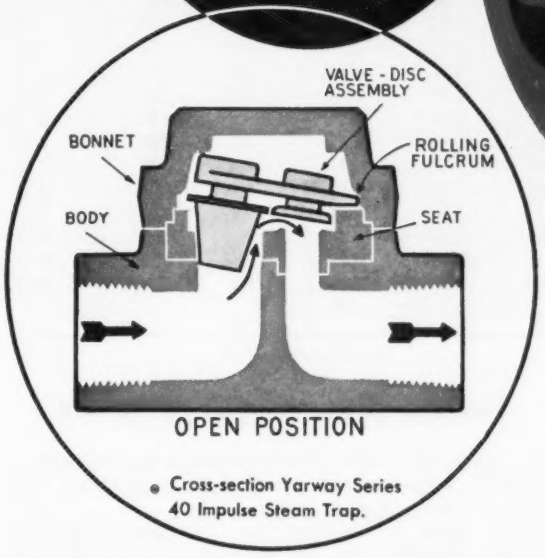
My biggest boner

Please turn to page 184

This YARWAY IMPULSE STEAM TRAP is for extra heavy* condensate loads

YARWAY SERIES 40





• Cross-section Yarway Series 40 Impulse Steam Trap.

The famous Yarway "impulse" principle of thermodynamics that revolutionized steam trapping many years ago, is now applied to a steam trap for extra heavy condensate loads—the Series 40 Impulse Steam Trap. Users report with this trap they obtain quicker heating, higher and more even temperatures in their process equipment.

It also incorporates all the other advantages of earlier Impulse trap designs, such as—immediate response to load changes, no air binding, light weight and small size. Maintenance is low, thanks to stainless steel body and working parts.

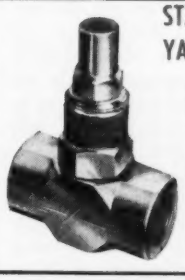
High condensate capacity of Yarway Series 40 Impulse Steam Traps makes them ideal for heavy condensate loads on large autoclaves, cooking kettles, dryers, heat exchangers, heating coils, presses, unit heaters, etc.

Suitable for all pressures up to 600 lbs. maximum, without change or adjustment. Operates against back pressures up to 50%. Five sizes, ½", ¾", 1½", 2" and 2½".

Your Yarway man will furnish a Yarway "40" for 90-day free trial in your plant without obligation, or write for Yarway Bulletin T-1746.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

*Examples: At 10 psig, ½", 1300 lbs./hr.; 2", 10,000 lbs./hr.
At 100 psig, ¾", 5600 lbs./hr.; 2½", 62,000 lbs./hr.



STANDARD SERIES 60 YARWAY IMPULSE TRAP

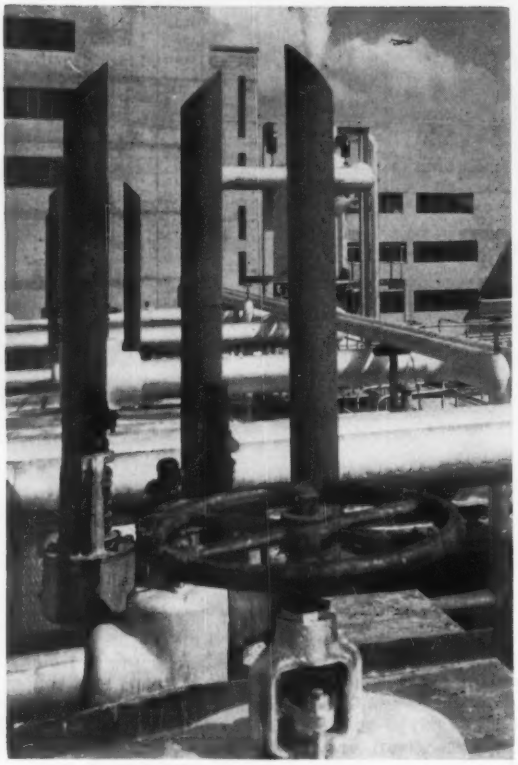
For normal steam trap applications the standard Series 60 Yarway Impulse Steam Trap is recommended. For *extra light* condensate loads use the ½" Yarway 20-A Impulse Steam Trap.

Send for Yarway Bulletin T-1739X.

YARWAY **IMPULSE® STEAM TRAP**

OVER 1,000,000 YARWAY IMPULSE STEAM TRAPS USED

Have a PLANT PROBLEM? *Tap the*



The problem

How fast should steam mains be warmed up?

I recently came across a problem on which I'd like to get the thinking of *Power* readers. Essentially it's this: At what rate should long large-diameter steam mains be warmed up in order to avoid excessive pipe stresses and possible damage to the main itself? What would be the safe rate for 100 ft of 24-in. diameter, schedule-80 pipe? Steam is at 750 psig, 720 F.

Are there any rules of thumb I can use? What factors affect warm-up rate?—*CV, June Power*

The solutions

Temp, F	In. per 100 ft: Steel	In. per 100 ft: Wrought iron	Temp, F	In. per 100 ft: Steel	In. per 100 ft: Wrought iron
0	0	0	520	4.39	4.58
20	.15	.155	540	4.59	4.78
40	.30	.31	560	4.78	4.975
60	.455	.475	580	4.975	5.175
80	.61	.63	600	5.17	5.38
100	.77	.80	620	5.365	5.58
120	.915	.96	640	5.565	5.785
140	1.075	1.13	660	5.765	5.99
160	1.235	1.29	680	5.965	6.20
180	1.40	1.46	700	6.17	6.42
200	1.57	1.64	720	6.375	6.625
220	1.73	1.81	740	6.58	6.835
240	1.89	1.98	760	6.79	7.05
260	2 065	2.16	780	6.99	7.275
280	2.23	2.335	800	7.21	7.49
300	2.41	2.52	820	7.415	7.73
320	2.59	2.70	840	7.63	7.93
340	2.76	2.87	860	7.84	8.145
360	2.935	3.05	880	8.055	8.37
380	3.11	3.235	900	8.28	8.60
400	3.29	3.43	920	8.495	8.82
420	3.465	3.62	940	8.72	9.05
440	3.65	3.805	960	8.945	9.28
460	3.835	4.00	980	9.17	9.52
480	4.02	4.19	1000	9.40	9.75
500	4.21	4.39			

Thermal stress must be minimized

CV's schedule-80 24-in. diameter 100-ft long steel pipe is, no doubt, class-A power piping of the steel-welded type. Its wall thickness is about 1.26 in.

Main factor in reducing expansion and temperature stresses is to cut down the difference between minimum and maximum temperatures and pressures as much as possible. Table, above, lists inches of linear expansion per 100 ft, from zero to 1000 F. If *CV's* header must be ready for service on short notice, he should keep it between 400 and 500 F with a steam-by-pass line. Steam flow through the header can be maintained with a ¾- or 1-in. diameter blowdown line similar to those used on superheaters. He can set the valve in a position that will permit condensate to be drained off and keep the main hot. Just before the main goes into service, he can turn the valve wide open.

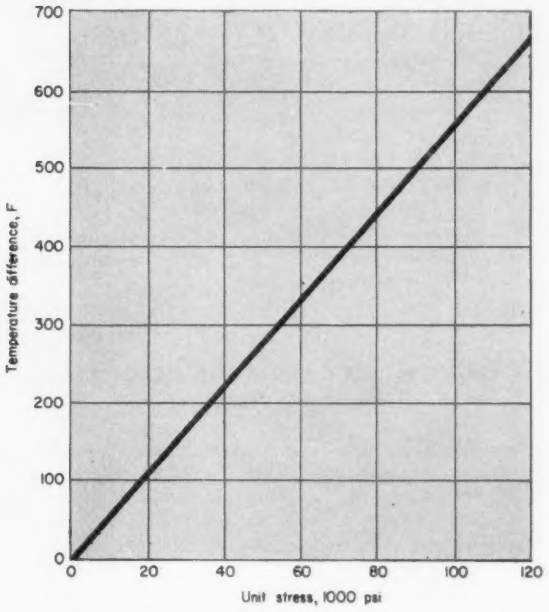
Steam at about 200 psi would be sufficient to keep mains hot. It could be supplied through a pressure-reducing valve in the by-pass line. After slowly opening the main high-pressure valve enough to allow high-pressure high-temperature steam to enter the main, close the drain valve off. Pressure then builds up gradually, but fairly rapidly, without sudden pressure and temperature changes. Table, above, shows that if main's temperature can be brought up to 400-

know-how of over 45,000 Power readers

HOWARD KALLEN, *Associate Editor*

500 F before main high-pressure valve is opened, linear expansion for the 100-ft header is only two to three inches. By figuring expansion per foot, *CV* can apply figures to any length pipe run. This will help him solve his problem.

A BELTON, *Montreal, Canada*



Is piping designed to expand?

Steam-flow rates during start-up are not normally governed by temperature limitations. The turbine, for example, is much more critical in this respect because of close running clearances between rotor elements and the casing. Here, a gradual temperature rise is important to avoid bowing of the shaft and interference between blades.

If piping is designed to absorb movement resulting from thermal expansion, excess stress problems shouldn't show up. Unit stress from temperature difference between operating and initial values can be figured from formula:

$$S = C \times E \times TD$$

where S = unit stress, psi; C = linear coefficient of expansion of pipe material, inches per inch per degree F; TD = difference between initial and final temperature, F.

Graph, above, is a plot of typical values of unit stress as a function of difference between operating and initial temperature for steel pipe. If we assume 60-F initial temperature and 720-F final temperature, stress is about 120,000 psi. For 24-in. schedule-80 steel pipe, resulting force is 10.5×10^6 lb. By correctly choosing expansion loops, and/or expansion joints, *CV* can keep effective forces within allowable limits. This is how I'd solve his problem.

H B WAYNE, *Woodhaven, N. Y.*

Here's a time-proven method

Length of time necessary to place a steam line in service depends on its length, size, material, initial and final temperature of pipe. Bringing the line up to steam temperature from a cold condition causes an excessive rate of condensation. Also, an abnormal amount of air must be eliminated from the system.

For safe warm-up, mark the expansion tube as close as possible to the packing gland. Repeat marks at ½-in. intervals, up to estimated linear expansion. Have all blows fully open to atmosphere. Crack the by-pass at the main valve only enough to allow sufficient steam to flow into the cool line, increasing its temperature slowly.

Before and during warm-up, piping should be checked for misalignment, to prevent a buckling or bending movement of the line. Continue opening the by-pass until all water and air has been removed. Then, close the blow nearest the main valve and throttle down valves to end of the line. But don't close end blow until there is enough pressure in the line to work the traps.

If steam line is quite long and by-pass doesn't provide enough steam to equalize the pressure, open the main valve slowly and at regular intervals, depending on the pressure rise and the movement of piping.

L F O'CONNELL, *Dearborn, Mich.*

Limiting factor is the system's ability to discharge condensate

Thermal expansion in 100 ft of 24-in. diameter schedule-80 pipe at 720 F should not be a serious factor in determining warm-up time *if* the piping system is engineered correctly. Limiting factor is the system's ability to discharge condensate as it is formed in the relatively cool pipe. Water hammer must be avoided since it can rupture the pipe or cause valve failure, particularly at the end of the line.

Closed gate valves are most susceptible to damage at end of the line because they can crack at the seat ring when struck by slug of water.

E W POWERS, *Mentor, Ohio*

Provide properly sized by-pass

In warming up any steam distribution system, a set of general operating instructions and safety rules should be set down by the chief engineer and strictly followed.

Using by-pass valves, exact warm-up time can vary between 5 and 60 minutes. These smaller valves reduce the force required to open the main valve because unbalanced pressure is less.

The following rules can be used to choose by-pass valves: From 4 to 8-in. lines, use ¾-in. by-pass; from 10 to 12-in., use 1-in. by-pass; from 14 to 16-in., use 1¼-in. by-pass; and from 18 to 20-in., use 1½-in. by-pass.

H B SWYGERT JR, *Columbia, S. C.*

Turn page for info on heating oil ▶

More PLANT PROBLEMS Begins on page 134

The problem

What's best way to heat lube oil for testing?

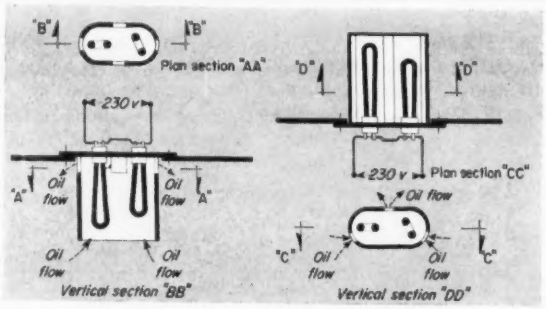
We've been using 5000-w 230-v calrod heating units in testing oil cylinders and tanks. The units heat lube oil to 350-400 F before oil enters test specimens.

These calrod heaters have been carbonizing from contact with the hot oil. Result is a heavy coating on the rods after they've been used for a period of time. Coating reduces heating efficiency and causes nonuniform oil temperature. We've been cleaning the carbonized coatings periodically, but this is a nuisance. And it doesn't really solve our problem.

Have readers had similar problems? Are there better ways to heat oil so carbonizing can be eliminated?

—THC, June Power

The solutions



Baffles improve circulation

THC can improve circulation of oil around the rods by installing baffles either in vertical or horizontal positions, as shown in the illustrations above.

J BORESTA, *West Englewood, N. J.*

Improve oil circulation across the heating elements

I believe that a high "skin" temperature is causing overheating or breakdown of the oil film on the heater surface. Here are two remedies that might be used by *THC*.

A pump will provide rapid oil circulation across the heaters. Care must be taken to keep all surfaces covered with oil. The oil inlet should be as near as possible to top of heater. Suitable pumping rate would be 5 to 10 gpm.

Second approach would be to purchase 10-kw 460-v heaters but use them on 230-v service. Heater would only put out 5 kw, but watt density would be cut in half and heater surface temperature would drop.

J I LACEY, *Niagara Falls, N.Y.*

THC should check watt density

THC says, "The heaters have been carbonizing from contact with the hot oil." Actually the opposite is true. Oil is carbonizing from contact with the hot heater. This is because the heater's "watt density" is too high.

Watt density of a heater is equal to the rated wattage of the heater divided by the effective surface, in watts per sq in. Manufacturers' catalogs recommend a density of 15 to 20 watts per sq in. for noncirculating oil and 30 to 40 watts per sq in. for circulating oil.

THC's 5000-watt heater should therefore have an effective surface area of 250 to 330 sq in. if the oil isn't agitated or circulated around the heater. If effective surface area is less than recommended, the heater produces heat faster than the oil can absorb it. Result: The heater overheats, oil in contact with it is scorched or carbonized and deposits on the heater. This not only reduces efficiency but shortens heater life because it's operating above normal temperature.

W A LINKE, *Chicago, Ill.*

Turn page for your new problems ▶

Westinghouse Men of Vision Plan New Atomic Fleet

First it was the *Nautilus*. Now Westinghouse is working on nuclear power plants for more units in the growing U.S. atomic fleet. Here is a chance for engineers to put their present knowledge to work on the ground floor of a new and growing industry . . . where they will be helping to guarantee the future of their country at the same time they are guaranteeing their own future.

Engineers in Westinghouse Atomic Power have assignments covering a broad range in the field of nuclear propulsion components . . . from specifications through manufacturing and test follow-up . . . to installation and operations.

No delay for security clearance; you can start working at once. Relocation allowances . . . and unique housing bureau will help you relocate in Pittsburgh, the renaissance city of America. Automatic salary increases, in addition to merit increases.

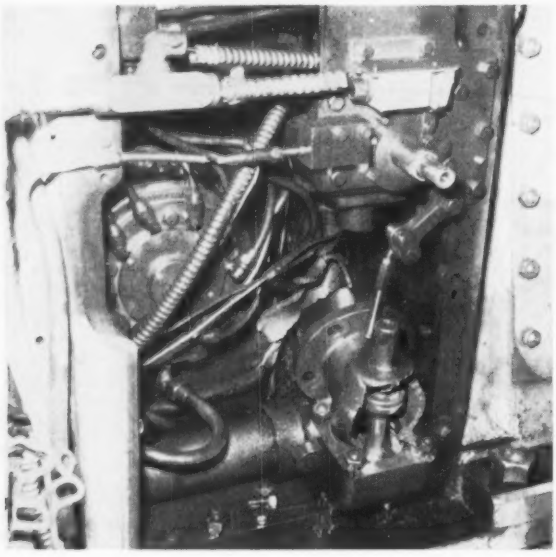
No prior atomic experience is necessary. If you have a background in pumps, valves, heat transfer, fluid systems, technical procurement, or manufacturing engineering liaison, send résumé to Mr. J. D. Batey, Westinghouse Electric Corporation, Dept. PK-107, Box 1047, Pittsburgh 30, Pa.

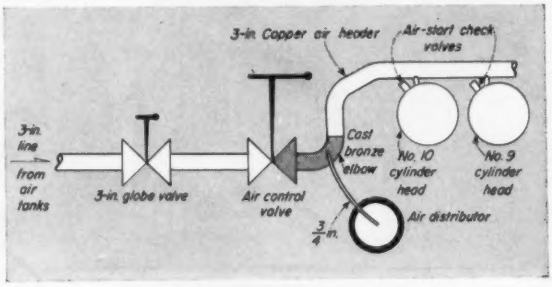
Westinghouse

FIRST IN ATOMIC POWER

. . . where atoms go to sea

Your October problems





What caused this dual-fuel engine explosion?

I'm superintendent of a plant that's equipped with four 3500-hp dual-fuel engine-generators. We furnish power to a ten-county area without tie-ins to other systems.

Recently, one of our regular shift operators was starting No. 2 unit when an explosion took place in the starter housing, injuring the operator and damaging the engine quite extensively in the vicinity of the air control valve.

When the explosion took place, the operator had just gone through the normal routine of starting the engine. He turned the upper lube pumps by hand, started the jacket-water pump, started the lube-oil pump, opened the 3-in. globe valve on the starting air line and then depressed the control handle to the start position. He later said that the engine had turned over several times when the explosion took place.

Upon hearing the loud explosion we shut off all gas valves because we first thought a gas header had exploded. The plant filled with a dense smoke and it was difficult to see any distance.

Measures were taken to balance the load on the two engines that were running, as they were both on emergency overload operation.

Upon further investigation we saw that the explosion took place inside the air starting valve and in an adjoining bronze elbow. Force of the explosion completely destroyed the valve and fitting. Several copper lines were damaged and the housing casting was broken, drawing and photo above.

Can *Power* readers tell us what caused the explosion and what action should be taken to prevent a recurrence?—*AAF*

How should this boiler repair be made?

We have an hrt boiler that has developed a circumferential crack in the knuckle of the front tube sheet, below the bottom manhole. This is a fatigue crack from the inside, and extends up both sides of the sheet approximately 18 inches but does not completely penetrate the metal. Our boiler inspector says no welding should be done in the knuckle of an unstayed head, but this tube sheet is supported by diagonal stays. And the tubes themselves have staying power.

Since this boiler is of all-welded construction, it seems to me that the practical repair would be to weld the crack instead of cutting out and replacing a section of the tube sheet all the way back to the head seam. Also, it is difficult to uniformly stress relieve so large a weld in the field.

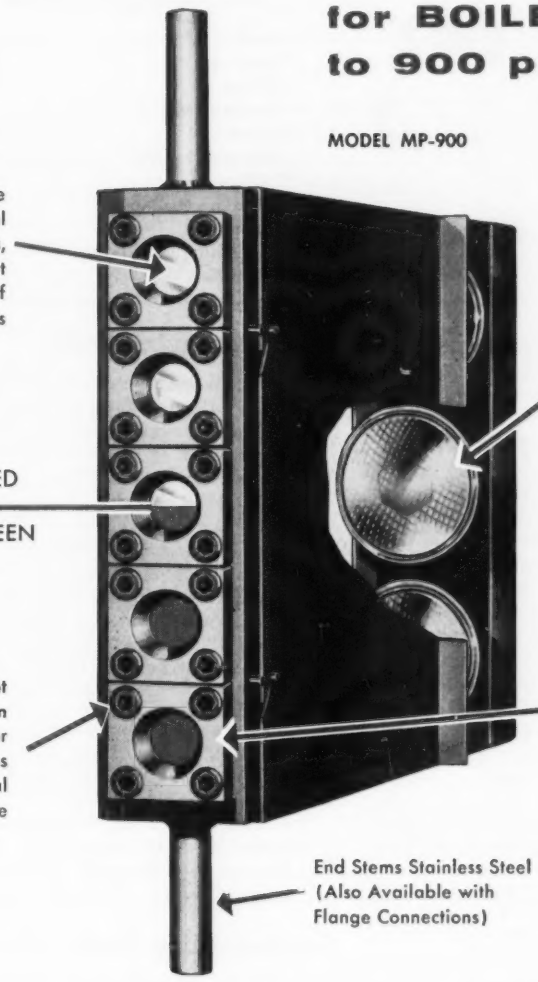
I'd like to get opinions of *Power* readers.—*HMP*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos, sketches.

Sure-Reading ...DIAMOND "Multi-Port" Bi-Color Gauge

for BOILER PRESSURES to 900 psig

MODEL MP-900


Ports Have Individual Round Glass, Mica and Gasket Instead of Long Strips
"Sealed Beam" Lamps in "Hi-Lite" Illuminator
STEAM SHOWS RED
WATER SHOWS GREEN
Complete Port Change and Cut Back into Service in Minutes Instead of Hours
Gauge Not Removed from Boiler for Gasket Changes and Other Normal Maintenance
End Stems Stainless Steel (Also Available with Flange Connections)

Also available is Model MP-3000 for boiler pressures to 3000 psig

The individual round ports each having its own round glass, round mica and round gasket (instead of the conventional long strips) means less stress and strain . . . resulting in greatly reduced maintenance. When replacement is required, it is usually only one port . . . which can be changed in a very few minutes . . . and without removing the gauge from the boiler.

The Diamond Bi-Color feature is another important advantage of the MP-900 Multi-Port . . . steam always shows red and water always shows green. There can be no question of the water level.

Recommended for both new and old boilers up to 900 psig, the MP-900 Multi-Port will give you a new standard of gauge operation. Use the coupon below for additional information.

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Please send me without obligation a copy of new Bulletin No. 2044 explaining the advantages of the Diamond MP-900 "MULTI-PORT" Bi-Color Gauge for all boiler operating pressures up to 900 psig.

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ARGUMENTS . . . *let other readers know your views*

ALTHEA THORNTON, *Assistant Editor*

Where was Marmy's escape pipe drain?

I don't say the incident in "Marmy's black gage glass," POWER, August 1957, did not happen, but, had the escape pipe on the *SS India Star's* safeties been properly piped up, there would have been a drain at the bottom of the pipe. And the escape pipe would have been independently supported from the relief valve. So any paint poured down the pipe would spill out, rather than come to rest on top of the valve disk, creating a static head on the valve itself.

Even if the pipe were connected solidly to the safety valve, and the watertender popped the safeties the next morning, black paint would have sprayed out of the escape pipe all over the funnel.

If Marmy's friend ran a really tight ship, why wasn't there a drain at the bottom of the escape pipe?

GEORGE DIEGLE, *Marion, Ohio*

MARMY'S NOTE: This reminds me of a big two-fisted bosun we had on the *SS Execorda* back in 1934. He had been skipper before the depression—but during the depression he was glad to get even a bosun's berth.

That year, lifeboat certificates were required for all seamen for the first time. So our bosun friend stood in line waiting to be examined by an inspector. The first question was, "How many fire axes are in a lifeboat?" Our bosun roared, "Not a goddam one in any of the ships I've sailed on, and I've been on ships since before you were in diapers." He got his certificate, because he was right.

Aboard ship in those days the escape pipes were bolted directly to safety valves. And of the many merchant ships I've been on, I've seen few drain lines. For one thing, the safety valves were always under a steel deck—and so hot up there that a few minutes was all anyone could stay. This was the condition on ships, especially with Scotch boilers.

So what happened when the safeties popped? Within a few minutes any condensation in the escape line would evaporate. So why drains? There is one h—— of a big difference in the way things should be in an ideal plant and the way they really are . . . and that goes for the *best* plant.

Numeration table

Name	*United States*	*Europe*
Thousand	10^3	10^3
Million	10^6	10^6
Thousand million	—	10^9
Billion	10^9	10^{12}
Thousand billion	—	10^{15}
Trillion	10^{12}	10^{18}
Thousand trillion	—	10^{21}
Quadrillion	10^{15}	10^{24}
Thousand quadrillion	—	10^{27}
Quintillion	10^{18}	10^{30}

Trillion or quintillion?

I want to comment on the last paragraph of "Nuclear Notes," POWER, May 1957, p 95.

The American system for billions, trillions and so on—said to be inspired in French practice—is leading to confusion in Europe.

Thus, in American nomenclature, 10^{18} is called quintillions, but elsewhere this is regarded only as trillions. The basic difference between meanings of the terms becomes enormous, see table above.

Now, as to who can claim priority and consequently, whose rules should be followed, I suggest that the terms, "thousand," "million," "billion," etc, were used in Europe long before 1492.

ANTONIO JOVER BARRIE, *Madrid, Spain*

EDITOR'S NOTE: Webster's *New Collegiate Dictionary* says, "According to the British and the German system, the billion is a million of millions, a trillion a million of billions, and each higher denomination is a million times the one preceding. According to the French and U.S. systems, the billion (or *milliard* in France) is a thousand millions, and each higher denomination is a thousand times the preceding."

Compensating tanks will solve problem

In June "Practical Ideas," H M Neuhaus set two additional solid anchors and a continuous series of confining supports to reduce vibration in compressor discharge pipe. I recommend a different solution.

Compressors should not discharge directly into a common line. Every movement of the piston produces a fluctuation in the line. Each section of the line has its own critical vibration frequency. Large diameter pipes can be easily excited at 265 rpm (Neuhaus' compressor speed.) When four compressors are working at unequal speeds, the line receives impulses of a frequency that changes periodically. Line vibrates periodically, too.

My solution is to place compensating tanks on every compressor outlet. Capacity of each tank must be at least five times compressor displacement. Tank outlets can be connected directly with the main line. If Neuhaus will include one more tank, of sufficient size, between the four compensators and the main line, his troubles will disappear.

ANATOLE OGIJENKO, *Buenos Aires, Argentina*

One in a series.

How to Select a Steam Trap Big Enough for the Job

Adequate capacity safety factors are essential to operating efficiency

As promised to you in a previous Armstrong trap advertisement in this publication, here is some helpful information on steam trap safety factors.

First, the definition. A trap safety factor is simply the ratio between actual continuous discharge capacity of the trap and normal condensate load. If the load is 500 lb/hr and the trap actually will discharge at the rate of 1000 lb/hr, the safety factor is said to be 2 to 1, and so on.

Why a Safety Factor?

You are not going to get maximum heat transfer efficiency from any steam heated unit unless your traps are sized with a generous excess of capacity over the normal condensate load.

Remember that trap capacity is given in terms of *continuous* discharge of condensate at a given pressure differential. If you don't employ an adequate safety factor, you make no provision for these requirements or conditions:

1. ***Venting of gas,*** O_2 and CO_2, would be impossible if a trap should discharge a full stream of water continuously.

2. ***Peak loads*** would back up condensate in the line or unit if the trap were sized for average load.

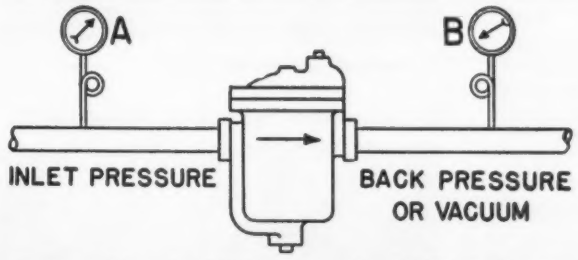
3. ***Reduction in pressure differential*** across the trap orifice would reduce capacity below requirements. If steam pressure drops below normal, trap capacity is lowered more than condensing rate. An increase in back pressure for any reason cuts trap capacity. And, pressure differentials often drop substantially during warming-up periods.

4. ***"Group" trapping.*** Very occasionally it is impractical to use an individual trap on each coil or condensing unit. Here, a generously oversized trap helps prevent backup of condensate or air from one unit to another. The frequent opening of a big trap valve "pumps" non-condensibles and condensate to the drain header.

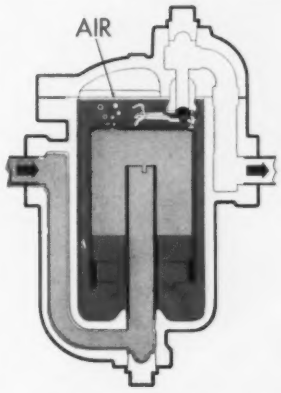
What Safety Factor?

Fortunately, it isn't necessary to calculate safety factors. Experience is the best guide and the benefit of experience with tens of thousands of successful installations is available to you. The following table is taken from the Armstrong Steam Trap Book.

Page	Equipment Drained	Safety Factors
24	Purifiers and Separators	2 or 3 to 1
25	Steam Mains or Headers	2 or 3 to 1
26	Steam Heating Pipes	2 to 1 up to 6 to 1
29	Unit Heaters	3 to 1
30	Submerged Coils	2, 3 or 4 to 1
32	Cylinder Dryers	4 to 1 up to 10 to 1



Pressure differential affects trap capacity. If "B" is back pressure, subtract from "A"; if "B" is vacuum, add to "A". Safety factors compensate for drops in pressure differential.



Traps vent air. This requires a trap capacity safety factor.

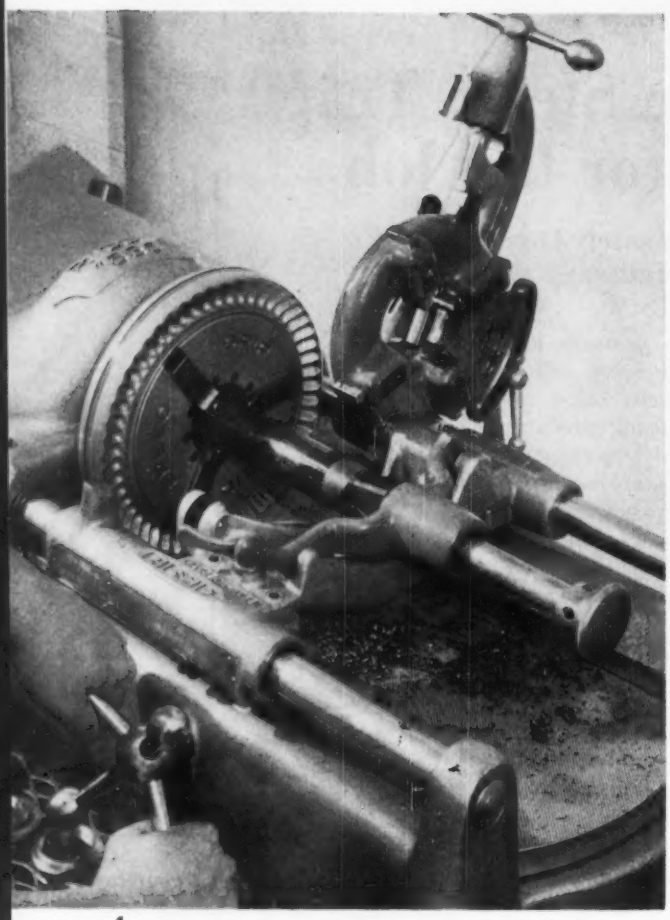
The page numbers listed contain completely reliable data for any trapping job.

CAUTION. The safety factors recommended in The Armstrong Steam Trap Book will have to be increased by an unknown factor for trap capacity ratings based on cold water tests, orifice tests or slide rule calculations. Armstrong trap steam temperature condensate capacity ratings are based on actual operating conditions which take into account such capacity-reducing factors as pipe friction and the choking effect of flash steam.

If you'd like to have a copy of the 44-page Steam Trap Book, just call your local Armstrong Representative, or write the factory. There is no obligation.

Armstrong Machine Works
8121 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS



1 Thread and ream one end of pipe

HOW TO

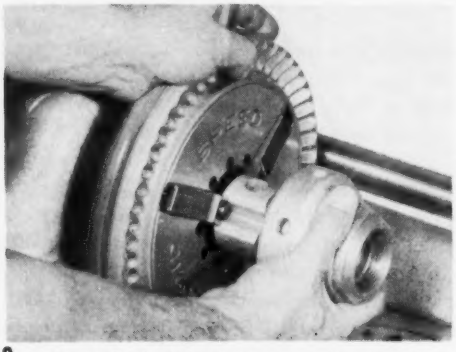
cut your own close nipples

► Now you can cut your own close nipples quickly and accurately with the nipple chuck and threading machine shown. The chuck fits any pipe threading machine. While very simple, it's foolproof. This chuck makes your threading machine turn out close nipples at production line speed.

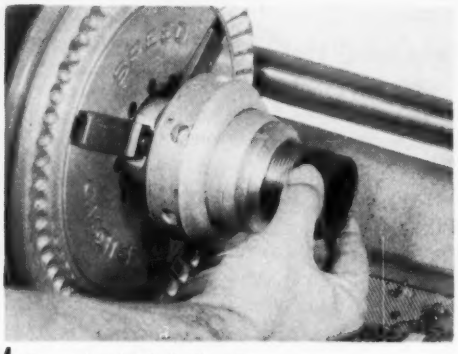
Nipple chuck fits quickly into the regular machine chuck and rigidly holds nipples of any length. Chuck holds standard pipe or conduit from ⅛ to 2 in. and studs and bolts from ¼ to 2 in. NC (course threads) and ¼ to 1½ in. (fine threads). British standard pipe adapters are also supplied. This is an economical way to greatly increase the versatility and value of your threading machine.

—Courtesy, The Ridge Tool Company, Elyria, Ohio

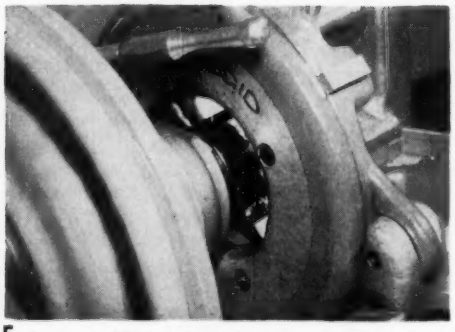
2 Cut off to desired nipple length



3 Lock nipple chuck in chuck, screw in adapter

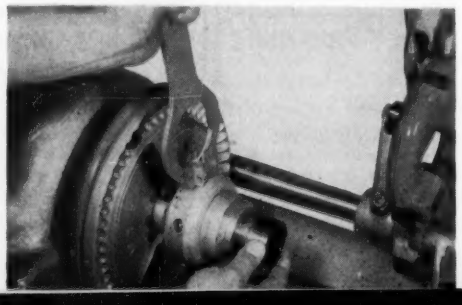


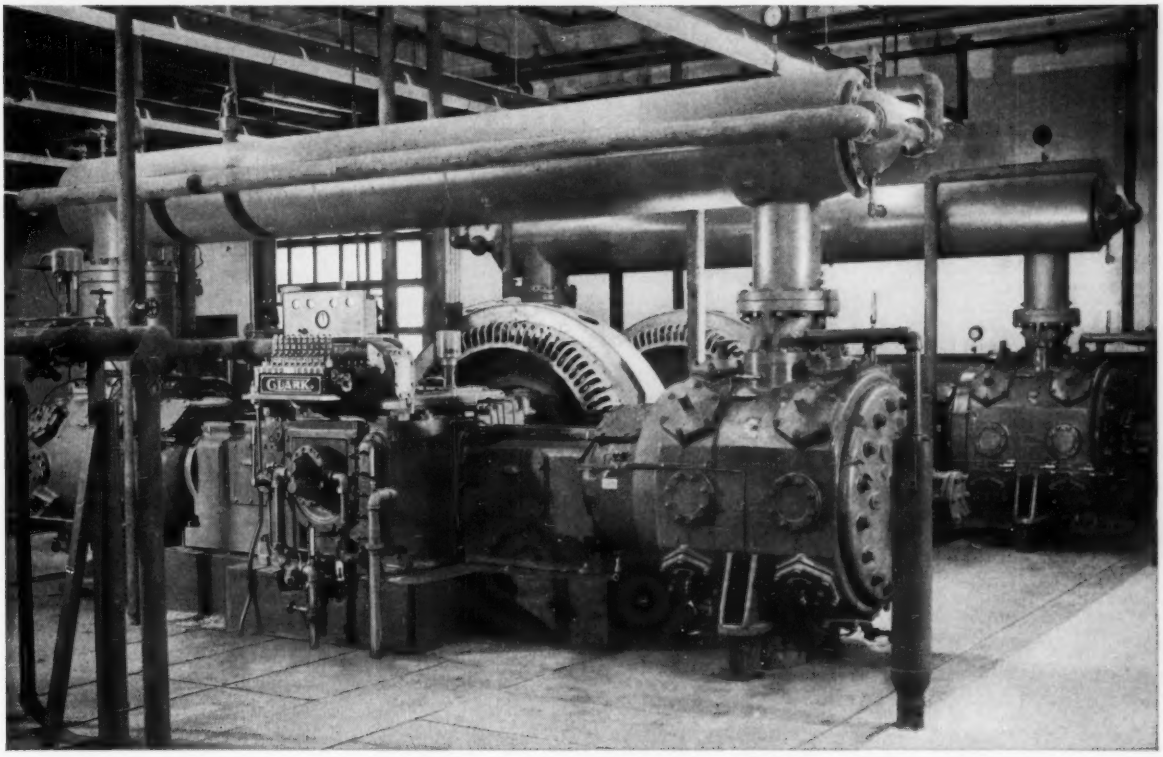
4 Screw in nipple by hand



5 Start machine and cut thread

6 Insert wrench and pull to release nipple





What Jules Verne couldn't foresee!

Around the world, 24,325 miles of it, in 45 hours and 19 minutes... our strategic B-52 bombers did it non-stop! This speedy trip made Jules Verne's "80 days" seem like a lifetime. Part of the B-52 – the electrical pneumatic units that drive generators to provide the muscle for operating flaps, gun turrets, radar and countless other operations are provided by Thompson Products, Inc. of Cleveland, Ohio. Four of these 205 horsepower units go into every B-52. To be certain they are perfect, Thompson gives them a thorough test before shipment. One 350 horsepower Clark CMA-4 and two Clark 600 horsepower CRA-2 air compressors furnish the air for testing.

There is a vibrationless Clark balanced/opposed compressor for practically every requirement. Sizes range up to 6000 horsepower. Your nearest Clark representative has all the facts.

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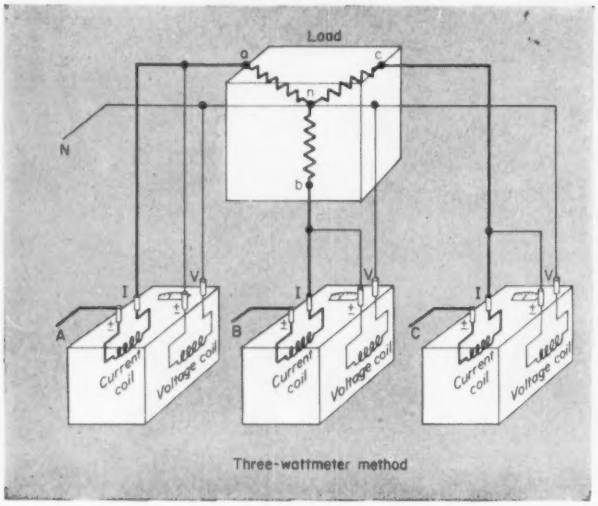
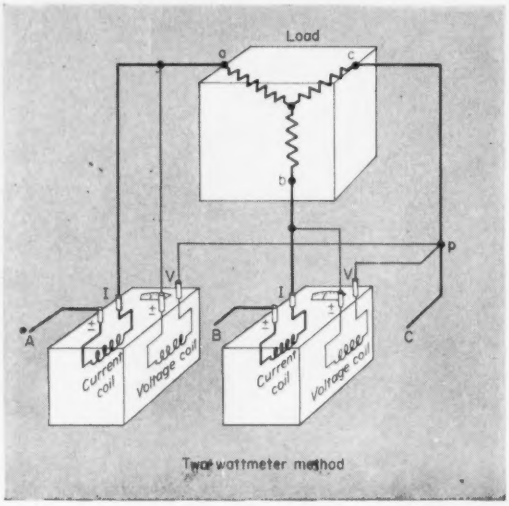
Balanced/Opposed Compressors

BASICS . . . *bringing engineering theory down to earth*

NORMAN PEACH, *Assistant Editor*





Electricity: 14

How to measure 3-phase power

► COMMON 3-PHASE CIRCUITS resemble the simplified circuits sketched above. Phase wires *A*, *B* and *C* have line voltage between them. In 4-wire circuit, right, the voltage between the center point, or *neutral n*, and any phase wire is $1/\sqrt{3}$ or 0.578 times the voltage between phase wires. This makes two voltages available in the electrical system. (There will be more about 4-wire systems next month.) Since in a 3-phase circuit one of the wires may be thought of as carrying the return current to complete the circuit for the other wires, it's possible to measure power using one wattmeter less than the number of wires. This means you will need two wattmeters for a 3-wire circuit and three wattmeters for a 4-wire circuit.

When measuring power in a 3-wire system, *be certain to hook up the wattmeters with the polarities shown above;* that is, so current flows through the current and voltage coils in the same direction. Opposite side of the voltage coils is connected to the third phase wire. Determine the power in the circuit as follows:

(1) If both meter needles have moved in the same direction, power is the sum of the readings.

(2) If one needle has moved opposite to the other, reverse the connection of the current coil of the meter which is reading in reverse. The power is found by subtracting the smaller reading from the larger.

Whether condition (1) or (2) exists depends on the power factor of the circuit. If for some reason you can't be certain of the polarities of the voltage coils, condition (1) should be further checked as follows: Remove the voltage-coil connection of the *low-reading meter* (let's say meter *B*) from the common point *p*, and attach it to the current-coil connection of the other meter (at *a*). If the reconnected meter reads in the same direction as before, add the original readings to get the power. If the reading is reversed, the low reading must be subtracted from the high reading.

When the load is balanced, that is, voltages *A*—*B*, *B*—*C*, *C*—*A* are equal, and currents *A*, *B*, *C* are equal, you can measure power with one wattmeter. In this case connect the wattmeter as at *A*; there will be no wattmeter in phase wire *B*, and the connection at *p* can be considered as being at *c*. Record the reading with this connection, then move the lead from *c* to *b* and record the second reading. If the needle moves in the reverse direction for one of the readings, reverse the current coil and take a new reading. The difference of the readings is the power.

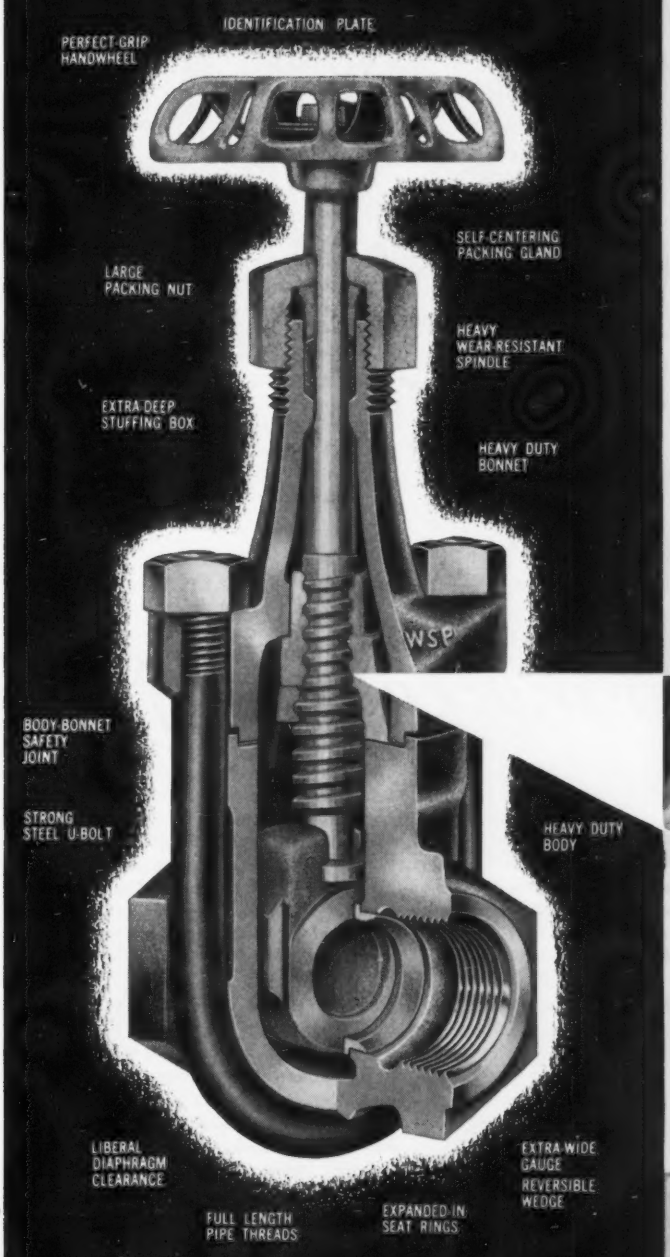
In 4-wire circuits, three wattmeters are required. Proceed the same as with two meters. Reverse the current coils of those meters which read reversed. If one meter has been reversed, find the difference between its reading and the sum of the other two. If two meters have been reversed, add their readings and find difference between their sum and the third meter reading. If load is balanced, wire *N* is not carrying current. Circuit is then essentially three wire, and one wattmeter can be used as described above.

Next month's Basics: Common 3-phase circuits

Only the big line of

JENKINS U-BOLT GATES

has all these dollar-saving features



WIDE CHOICE

Inside Screw and O.S.&Y., patterns . . . Iron Body with Bronze or Stainless Steel Mounting, All Iron, Ni-Resist with Type 316 Stainless Steel trim. GET FOLDER NO. 207 about the complete line. Ask your local Jenkins Distributor, or write Jenkins Bros., 100 Park Avenue, New York 17.

Priced no higher

DESIGNED TO COST LESS TO USE

Built right into a Jenkins U-Bolt Gate Valve are dollar-saving features no other can match. Construction superiorities that equip this valve to take punishment longer . . . saving dollars in replacement bills. Features that cut maintenance time and the cost of replacement parts . . . saving more dollars. For a good example, look at the unique Renewable Bonnet Saver Bushing which is a patented feature of Inside Screw valves.

BONNET-SAVER BUSHING

No need to junk a bonnet with worn operating threads. Just slip in a new bushing for good-as-new thread engagement . . . saving bonnet and lengthening spindle life.

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

JENKINS SINCE 1864

Jenkins Bros.

Sold Through Leading Distributors Everywhere

"Rose left to do her stuff with the band, while Hung and I went into a huddle about the refrigeration plant," roared Marmaduke

Marmy's flaming cold stuff

► "BILGEWATER on shady operators," roared Marmaduke Surfaceblow in his foghorn voice when I visited the Bent Propeller Bar yesterday. "I'll tell you dry-land throttle pullers how I quick-froze a crooked Parsi chemist, and all I used was a sawed-off candle."

This blast was startling to say the least. The busy joint quieted down as weather-beaten mariners lowered their mugs of grog to give their hero undivided attention. The old consulting engineer turned his back to the bar and surveyed his listeners. I sat down at a table and waited to record his words of wisdom for posterity.

Backing up to the bar, Marmy roared away, "Back in 1920 I pulled into Colombo, Ceylon, aboard the tramp freighter *SS Gatske*, registered out of Glasgow, Scotland. That evening while taking on liquid refreshments at the Maliba Bar across from Crow Island, I ran into my old friend Yum Ling Hung, notorious Far East trader. Drinking with him was Rose Sahibo, the hottest Turkish nightclub entertainer in the Orient.

"I had been engineer on one of Hung's South Sea schooners several years before when he was island hopping and trading in pearls. He asked me to join them in a round of Singapore gin slings. Hung was a dapper looking guy with shiny black hair. He wore a snow-white linen suit with flashy pearl buttons. A red poppy flamed out of his button hole like a blowtorch.

"After greetings and salutations, Rose left to sing and sway her womanly charms before the paid customers. Hung seemed happy to have a chance to talk privately. 'Marmy,' he began, 'how you like make plenty money?'

"'What's the deal?', I asked, giving him one eye but keeping the other glued on Rose's curves as she sang a scorching love song in French.

"'I have deal, buy old Jaffergee Ice Co here,' began Hung again. 'Icehouse plenty shot, plenty junk. I buy for

(*Continued on page* 172)

ONE-SHOT "BOILER TREATMENT" GETS UNEXPECTED RESULTS

CEMENT MANUFACTURER SHOOTS THE WORKS!

CLEANING rotary cement-drying kilns by firing lead slugs into them to knock off accumulations inside is routine practice. The slugs go bounding and bouncing through the long drying kiln, doing a cleaning job equivalent to a whole crew of pick-and-shovel pilots. No one expects a slug to become so enthusiastic that it continues its chores inside the waste heat boiler attached to the far end of the kiln. In fact, the odds against getting a slug into the boiler *on purpose* are astronomical. But this one got there, odds and all, thus establishing a new type of one-shot boiler treatment which is hardly likely to become popular.

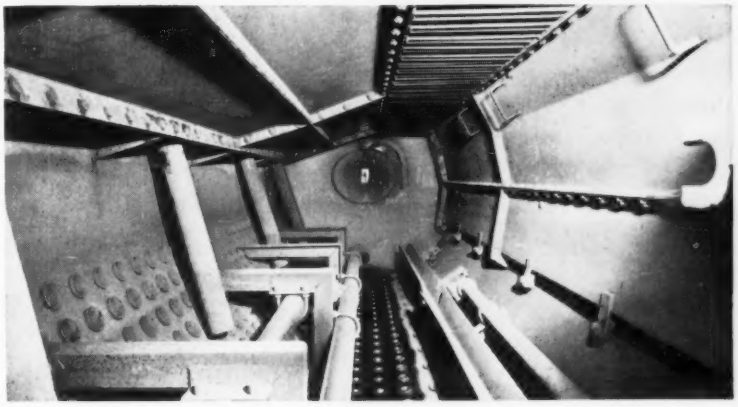
HOWEVER, *inside* the boilers at this large cement plant, Nalco System treatment helps make certain that boiler troubles, if any, are on the outside. Boiler feedwater is aerated, filtered, zeolite softened, evaporated and deaerated. A Nalco corrosion inhibitor is fed between deaerators and feed pumps for corrosion control throughout the steam and condensate return systems. Nalco catalyzed sodium sulfite does the oxygen scavenging on the discharge side of feed pumps. A Nalco internal treatment and caustic soda are fed directly into the boiler for pH control and scale prevention.

It is no wonder these boilers can turn out 169,000 lbs. of steam per hour, year after year, and stay like new—except, of course, for the wayward shotgun slug.

Nalco has not yet developed bullet proofing for boilers . . . But you can never tell what may come next! Meanwhile, we'll be happy to tell you more about effective Nalco Internal Treatment. Ask for Bulletin B1. National Aluminate Corporation, 6222 West 66th Place, Chicago 38, Illinois. In the Northwestern United States, Hawaii and Alaska: The Flox Company, Inc., Minneapolis, Minnesota. In Canada: Alchem Limited, Burlington, Ontario. Branches and affiliates in Spain, Germany and Italy.

THE TREATMENT: Lead slug, propelled by heavy powder charge in 8-gauge shell fired from a miniature cannon! "External treatment" with a vengeance.

THE RESULTS: "Plugged" boiler tube, pierced by lead slug on the pay off to one chance in a million. Internal treatment powerless here.



Steam drum in one of the Nalco-treated boilers at cement plant is typically clean and corrosion-free when opened for annual inspection.

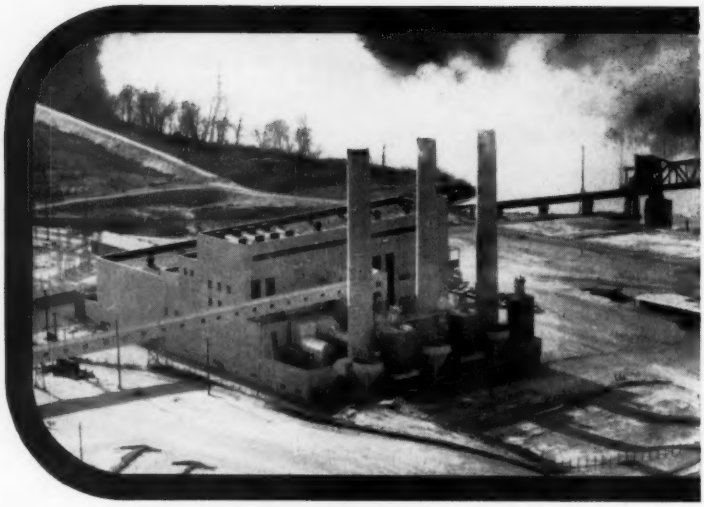
Water treatment chemical mixing and proportioning room, where Nalco System treatment starts on its way to give complete steam system protection against scale and corrosion.

South Carolina Generating Company's

(Wholly-owned Subsidiary of South Carolina Electric & Gas Co.)

URQUHART STATION

UNIT No. 3



where . . . **REPUBLIC** *Automatic*

COMBUSTION CONTROLS *Anticipate* **FUEL-AIR-WATER REQUIREMENTS!**

BRIEFLY—this is how it works:

Controls Respond First to Load Changes

REPUBLIC "Electronic Master" combustion control first detects any change in steam flow and immediately transmits a signal proportional to that change to the combustion air, coal pulverizers and/or gas valve, and feedwater valve.

Curb Pressure-Water-Temperature Changes

Corrective settings of each of these controls starts *with* the steam flow change and follows the change closely; this keeps steam, fuel, air, water and (of course) flue gas flows in the closest possible balance, minimizing fluctuations of header pressure, drum water level, and superheater outlet temperature.

Pressure Controls Follow Up

Any slight change of header pressure or drum level that *does* occur is immediately detected and fed to the proper control as a modulating signal that restores complete balance . . . quickly.

Combined Fuels—Stable Operation

This combination of flow-initiated and follow-up adjustments, with electronic control and pneumatic drive units, means top-notch stability, accuracy, sensitivity and reliability for Urquhart Station's Unit No. 3, even while burning combined fuels!

REPUBLIC FLOW METERS CO.

A Subsidiary of Rockwell Manufacturing Company

Urquhart No. 3's control room where automatic and remote-manual controls are centralized.

URQUHART STATION, UNIT No. 3
STEAM DATA:

Rated Capacity 700,000 LB/HR ——— 1825 PSI
SUPERHEAT 1010 F ——— REHEAT 1010 F
FUEL: PULVERIZED COAL AND/OR GAS
COMBUSTION CONTROL:
REPUBLIC Automatic ELECTRONIC

Planned expansion of power for the great Southeastern United States is typified by the latest addition to Urquhart Station of the South Carolina Generating Co. Planned by Gilbert Associates, Unit No. 3 is modern today and will be modern tomorrow —*and will be considered "modern" by performance as well as appearance standards.*

REPUBLIC's "Electronic Master" combustion control is a logical partner in such advanced thinking. The quick, long arm of electronic control plus reliable, powerful actuation by pneumatics gives Urquhart No. 3 the reflexes it needs to meet any operating crisis and hold single—or combined—fuel consumption low. For greatest speed of control, REPUBLIC has provided a load-responsive system that regulates all combustion factors *before* pressure drops or jumps occur. Any pressure fluctuations following this advance adjustment are very limited and are promptly compensated by a pressure control system that modulates the fuel and air control signals.

REPUBLIC's three element feedwater regulator adjusts feedwater flow in proportion to steam flow, and follows up this action with a correction for drum level. Total level fluctuations are thereby held to a strict minimum.

Remote manual operation of any or all control units is possible at any time. The operator need only throw the transfer switch on his panel and take over; indicators at the operating station show electronic loadings to the regulators and positioners, and show the rate of response and position. All electronic amplifiers have built-in surplus capacity for extra life and special design features for quick maintenance when needed.

This comprehensive treatment of control problems is typical of REPUBLIC engineering. Equally thorough follow-up and servicing make REPUBLIC a helpful partner in new or modernized power operations—of any size.

Need Help With "Early Stage" Planning?
If you are planning ahead for new conventional or "unconventional" facilities, remember that REPUBLIC, too, is planning ahead. For help in projecting your new facilities in terms of new control, metering and recording equipment—and the latest in top quality valves—contact REPUBLIC's Engineering Department as soon as this help can be beneficial.

2240 Diversey Pkwy., Chicago 47, Illinois

Reader service section

Start with these quick samples...

Hot enough for you? . . .

That old saw has a new meaning for scientists at National Carbon Co's labs. They've figured out a method for producing temperatures up to 7000 F—a new high. What's the reason? Well, it's predicted that there are some hot times ahead for industry, with more and more operations calling for intense heat. These boys are going to be ready.

Reports from the field, p 152

A cycle built for two . . .

A combined gas and steam cycle, its design and characteristics, is described in this month's lead paper. Advantages of cycle derive from the higher inlet temperatures permissible on gas turbines which result in larger temperature drop on working fluids. This in turn contributes greatly to theoretical efficiency. For the rest of the story . . .

Technical briefs, p 154

Did you hear the one . . .

about the guy who . . . but why should we spoil a perfectly good joke when you can see it for yourself on page 160. Incidentally, you'll find yourself right in the middle of the new equipment section when you get back there, so take a few minutes for window shopping. There's a sampling of meters, pumps, electrical equipment. You name it—we've got it in . . .

Plant equipment news, p 158

Hard sell, soft sell . . .

No matter which a manufacturer favors, he knows there's one approach that helps him get his product across—free literature. That's why he goes to all the trouble of preparing and printing these brochures. He wants you to get to know his product. It's to your advantage to do so—saves a lot of shopping around. So send for . . .

Free literature, p 167

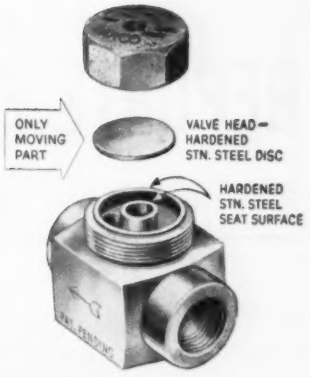
Let George do it . . .

He's the man who can brighten your day with a chuckle, or leave you a bit the wiser for one of his homespun homilies. The George in question is our engineer-philosopher George Edwards, who discusses the problem of communication this month. If you've ever wondered how you might improve relations with your employees or fellow workers, read . . .

George Edwards, p 170

For other timely ideas, see following service pages▶

HOW TO
reduce steam trap inventory and practically eliminate maintenance
with the unique Sarco TD Thermo-Dynamic



ONE TYPE OF STEAM TRAP FOR PRACTICALLY ALL APPLICATIONS

The Sarco TD Thermodynamic is the most versatile steam trap ever developed.

It has large capacity . . . but small size. Insures rapid, continuous, complete drainage of condensate at saturated steam temperature. Has high air venting capacity.

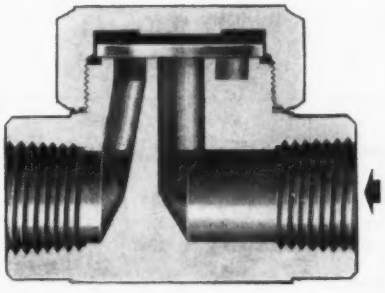
Operates perfectly on all loads . . . and when pressure fluctuates. Freeze-proof, when installed with outlet down. Highly resistant to superheat, water hammer, corrosive condensate.

ONE LARGE CAPACITY SEAT FOR ALL PRESSURES — 10 TO 600 PSI

Yes, in each size Sarco TD trap the same large capacity seat accommodates all pressures 10-600 psi . . . for heavy, light, or no condensate loads. Sizes ⅛ to 1".

Self-adjusting throughout entire pressure range . . . not a single change or adjustment required.

No need to stock seats and heads for various loads and pressures. Inventory simplified and reduced.



TROUBLE-FREE DESIGN NO VALVE MECHANISM — ONLY 3 PARTS

Look at that cross-section, left. That's all there is to a Sarco TD! What could be simpler?

Only 3 simple, rugged parts (single pieces — not assemblies) . . . all stainless steel. Only *one* moving part . . . a solid hardened stainless steel disc.

No mechanism . . . the kinetic energy of steam closes the valve. No narrow channels to choke. No gaskets to leak.

Actual service experience . . . in hundreds of plants . . . under severest conditions . . . has proved that the Sarco TD PRACTICALLY ELIMINATES MAINTENANCE.

2215-B

SARCO Thermo-Dynamic TRADE MARK **STEAM TRAP**

60-DAY TRIAL CONVINCES

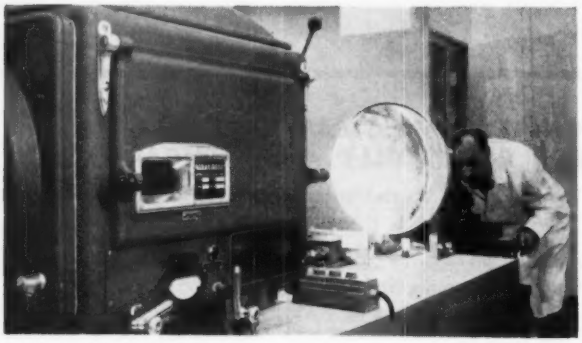
We will gladly send you a Sarco TD steam trap and strainer for 60-day trial. No cost or obligation. You buy only if completely satisfied. Advise size — ⅜, ½, ¾ or 1" — and application. Sarco Company, Inc., 635 Madison Avenue, New York 22, N. Y.

THE MODERN TRAP THAT IS MAKING STEAM TRAPPING HISTORY!

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 232



TWO MOVIE MIRRORS *above* focus carbon arc, heat materials to 7000 F for high temperature research. Seconds after exposure to the high energy beam, the fire brick *right* melts to red lava

Arc-image furnace matches sun's heat

► WHEN THEY MIGHT be savoring the cool of autumn, scientists in National Carbon Co's labs are pursuing Old Sol with the enthusiasm of mad dogs and Englishmen. Using a carbon-arc lamp and two movie-projection mirrors, they've produced a sizzling 7000 F—man's closest approximation of the sun's surface temperature.

The method in this apparent madness lies in the present need for intense heat in metallurgical and other research and in the probability that industry's future operations will require higher and higher temperatures.

Man has known for a long time how to generate intense heat by using mirrors to collect and concentrate energy rays. A solar furnace, incorporating this principle, was reportedly used by Archimedes in 212 B.C. to burn up a Roman fleet. The carbon-arc furnace, second source of man-generated heat, was discovered in 1801.

But these traditional sources have limitations. The old-style carbon-arc furnace produces carbon impurities; sun-powered furnaces are good only when the sun is shining. The new design projects the arc beam through a window for complete purity, comes up with solar temperatures day and night,

(*Continued on page* 228)

Power Lines

An electric powermaker which exhausts its steam horizontally along the axis of the turbine shaft and into the condenser, rather than downward into a condenser, is GE's latest. For photo and story see page 230.

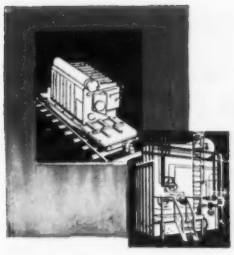
Puerto Rico reports a record high in power consumption—further proof of Operation Bootstrap's success. Power generation increased 18.1% in fiscal 1957, while power sales jumped to over 1¾ billion hours, producing a record revenue of $29 million.

With Calder Hall celebrating its first birthday, Britain announces that it's ready to start work immediately on the world's largest atomic power station. Output will be 500,000 kw—six times the capacity of Calder Hall. Site: Hinckley Point, Somerset, England.

College graduates, the bonus babies of engineering, are no longer the only beneficiaries of rising payrolls according to the American Society of Civil Engineers. Report shows that since 1955, wage increases have been distributed throughout the salary scale.

If Junior has trouble getting shot for his BB gun, tell him to blame Westinghouse. Scientists there have discovered that they make an excellent shield against radiation—are currently using 35 tons of them between walls of a hot cell being used for nuclear research.

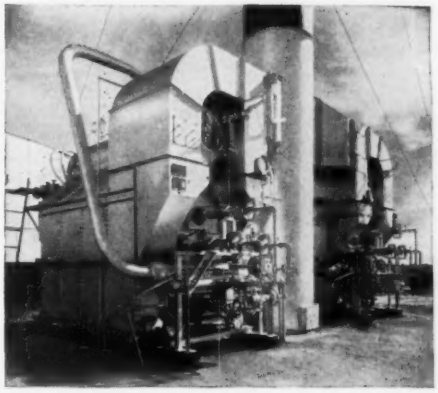
Discovery of element 102—first new element to be made since 1955—has been announced by United Kingdom Atomic Energy Authority. It was isolated at Stockholm's Nobel Institute. Possible name: Nobellium.



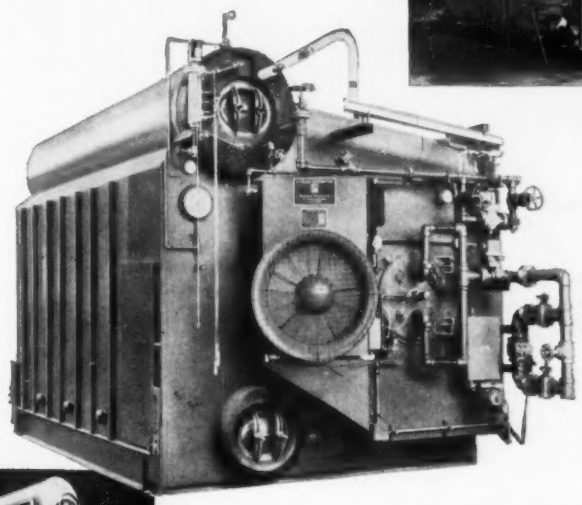
HEAT ENGINEERING by FW

extends Central Station Reliability to Standard INDUSTRIAL and PACKAGED UNITS

PACKAGED STEAM GENERATORS of the water-tube type were introduced by Foster Wheeler in 1940 — combining in a single, compact, shop-assembled unit, all the necessary facilities for the dependable and economical generation of industrial steam. Continual research and development have resulted in further improvements in design and construction, and today the FW line of Packaged Steam Generators, in capacities from 10,000 to 60,000 lb/hr, represents the last word in modern steam plant design, reflecting over half a century of service to the power generation industry. Features include 36″ steam drum and 24″ water drum, staggered boiler tubes, closely spaced waterwall tubes, water-cooled target wall, and wide choice of burners and controls.

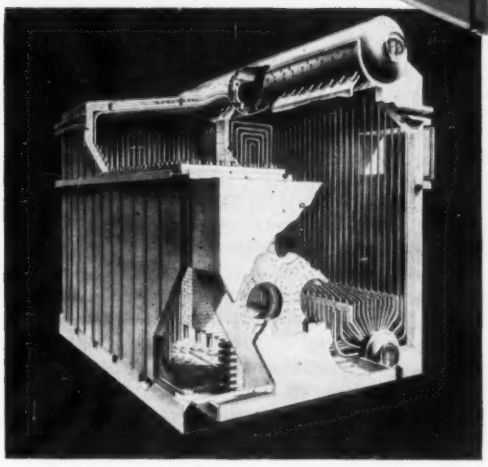


Above: Two FW packaged boilers — the first ever offered to industry — were installed for oil field drilling operations in 1940. They are still in service, delivering low-cost steam.



Left: New Foster Wheeler series AG-100 Packaged Steam Generator.

Cutaway view of typical FW Standard Steam Generator



STANDARD PRE-ENGINEERED UNITS by Foster Wheeler offer all the advantages and economies of *standardization* for larger industrial steam generators of from 50,000 lb/hr to 450,000 lb/hr capacity. The new FW line of "SC" and "SD" standard units is heat engineered to the same standards of dependability and performance which have made Foster Wheeler steam generators first choice in many of the leading central station plants throughout the country. Features include completely water cooled walls, efficient firing arrangement, fully drainable superheater, high steam purity, unrestricted circulation, pressure-tight construction and minimum refractory baffling. For further details, send for Bulletin B-55-4.

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TECHNICAL BRIEFS

Latest engineering developments for busy power men

16 papers for you on
STEAM CYCLES
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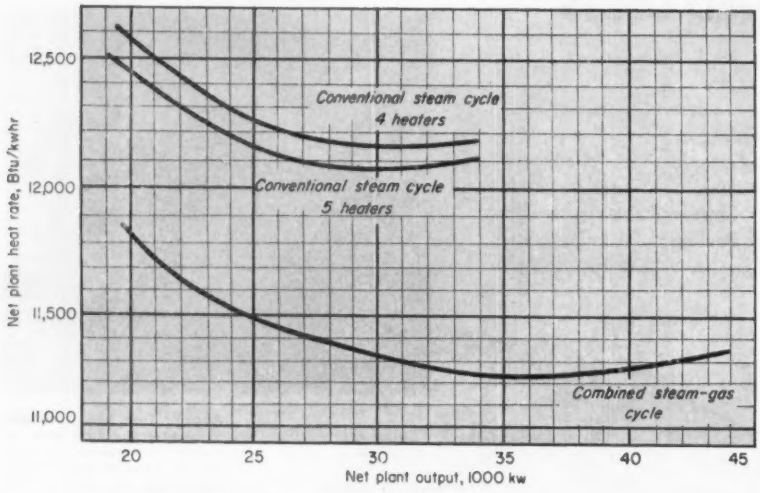


KEY TO INCREASED EFFICIENCY achieved by replacing steam cycle with combined gas-steam cycle lies in higher inlet temperatures allowed on gas turbines

Weigh advantages of gas-steam cycle

Design and characteristics of a combined gas and steam cycle of 40,000 kw capacity. *By A R LeBailly and L Skog Jr, Sargent & Lundy.*

The advantage of the combined gas-steam cycle is derived from the higher inlet temperatures permissible on gas turbines than on steam turbines. This results in a larger temperature drop on the working fluids and offers a very significant gain in theoretical efficiency.

Experience has proved that the commercial reliability and availability of gas turbines is practically the same as steam turbines. While the efficiency of the simple gas turbine is lower, its quick starting characteristics make it more suitable for operation for seasonal and peak shaving loads. The greater efficiency of the combined gas-steam cycle would justify sustained operation of a gas turbine in conjunction with a steam turbine and the combined heat rate would be comparable to that of a steam cycle of higher pressure and temperature design.

Directions for ordering papers on page 220

This paper describes the design and characteristics of an application of a combined cycle to an existing gas turbine. The installation is being made at Rio Pecos Power Plant of West Texas Utilities Company. It will use a gas-steam cycle with gas-turbine exhaust as combustion air. The steam turbine is a preferred standard 33-mw unit with steam conditions of 850 psig, 900 F and backpressure 2-in. Hg abs. The existing gas turbine installed in 1954, is a 5000-kw simple-cycle single-shaft unit.

The installation offers these advantages: (1) Combined efficiency is increased 7.4% over the conventional four heater steam cycle, see chart. (2) Overall plant investment is slightly lower. (3) Retains a high load factor on the comparatively new gas turbine. (4) Boiler closely resembles a conventional unit and does not require the development of new design or untried components. (5) The gas turbine and steam turbine can be operated independently in case of an outage of either one. (6) The combined cycle should be as reliable as a conventional cycle. *APC paper, no number.*

Future of the steam turbine cycle. *By C W Elston and J E Downs, General Electric Co.*

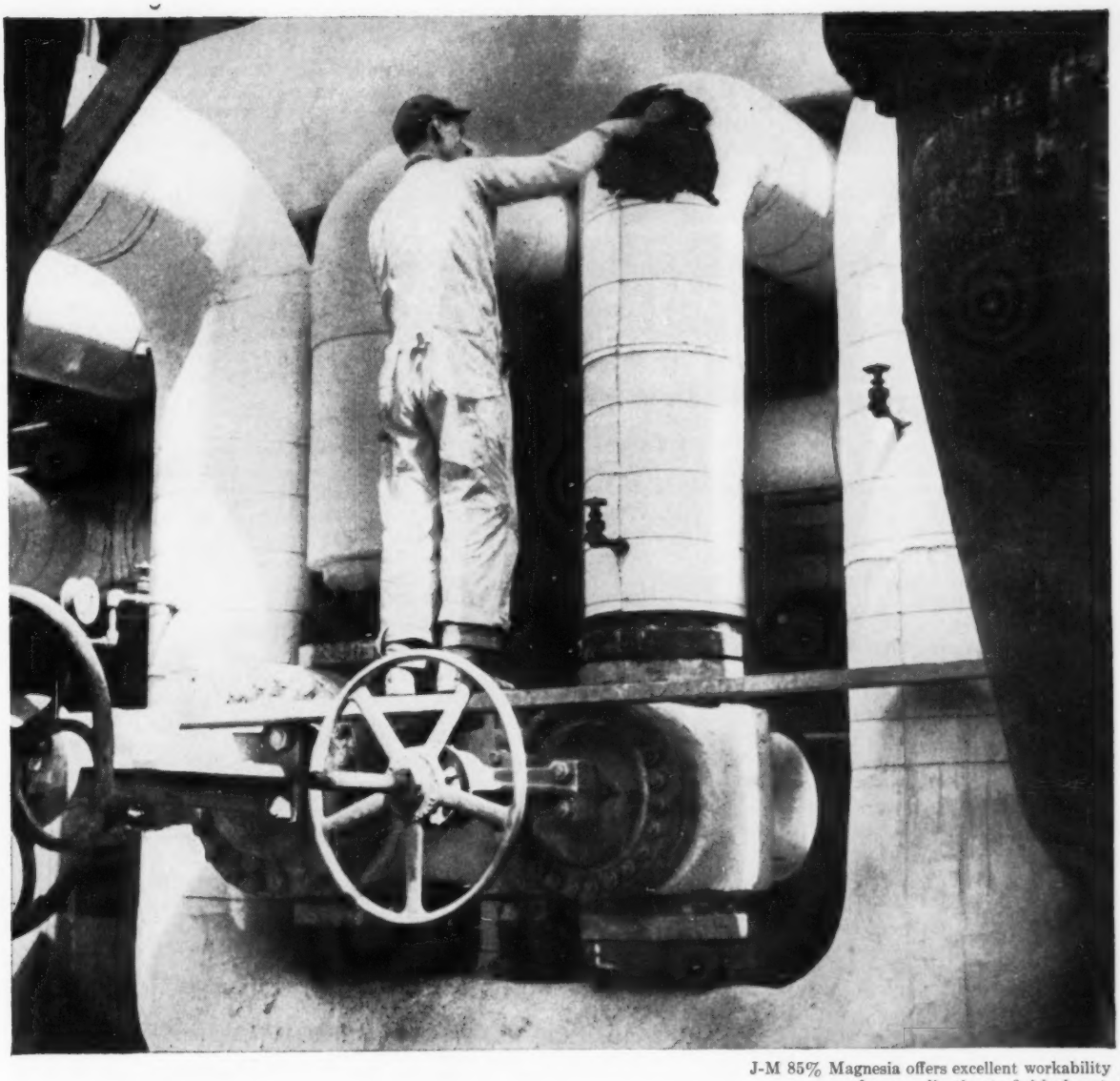
The average turbine size being shipped by the author's company to electric utilities has increased from 38,000 kw in 1947 to 156,000 kw in 1957, an average increase of 15% a year. The largest unit in service is the 260,000-kw unit at River Rouge Station of Detroit Edison Co. For the immediate future, the highest steam conditions for which a turbine has been shipped and is now ready for service is 4500 psig, 1100/1050/1050 F for the Philo Station of American Gas and Electric Co. These conditions will be exceeded by the Eddystone No. 1 unit now being built for 5000 psig, 1200/1050/1050 F. The largest on order are the 450,000-kw units for Breed Station of the Indiana-Michigan Electric Co and the Philip Sporn Plant of Ohio Power Co.

The paper explores fuel savings available from higher steam conditions along with the present economic limitations on further advances, and also, the need for new ideas and developments to permit the economical application of more efficient cycles.

The authors conclude that studies of heat rates available from further advances in steam conditions reveal somewhat decreased percentage gains. The larger aggregate generating capacity to be installed in the future, although coupled with smaller percentage gains, provides even more incentive for making such gains economical than has existed in the past. At the present, it appears that the capital cost of the next immediate step in steam conditions is several times the worth of the fuel savings. Obviously, new ideas or new materials are needed. Possible alternate avenues include other working fluids, different equipment designs, and different arrangements of station components. Many of these alternates have been or are being evaluated. *APC paper, no number.*

Steam station auxiliary systems for large high-pressure turbine-generator units. *By A C Dolbec, J J Heagerty, A G Mellor, General Electric Co.*

This paper compares various auxil-



J-M 85% Magnesia offers excellent workability . . . from application to finished coat.

Install lasting fuel savings and lower maintenance costs

. . . with J-M 85% Magnesia insulation!

At temperatures to 600F, no insulation is so widely used, or so closely associated with economy and increased operating efficiency as 85% Magnesia. Any wonder, then, that 71% of insulation maintenance engineers responding in a recent survey made 85% Magnesia their first choice in its temperature range.

There's good reason for this overwhelming acceptance. For J-M 85% Magnesia offers many practical advantages in both installation and service. Lightweight and readily workable, 85% Magnesia assures fast, easy application. In operation, it provides the ultimate in insulating value—long life—virtually no replacement—and the very minimum of maintenance.

To assure you maximum value in insulation application, Johns-Manville offers you complete planning and job-site service . . . practical recommendations by the world's most experienced insulation engineers, backed up by expert installation by J-M Insulation Contractors.

Write today for further information on Johns-Manville 85% Magnesia Insulation. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada: 565 Lakeshore Road East, Port Credit, Ontario.

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Johns-Manville INSULATIONS FOR LASTING THERMAL EFFICIENCY

MATERIALS • ENGINEERING • APPLICATION

More TECHNICAL BRIEFS

Begins on page 154

iary system arrangements for units from 200,000 to 600,000 kw at steam pressures of 2000, 3500 and 4500 psig.

The authors conclude that: (1) It is more economical to keep the auxiliary system at 4.16 kv, whether by use of more buses or by consideration of higher rated 4.16-kv switchgear, than to go to a higher voltage system. (2) Based on estimated costs for the proposed 4.16 kv (350-mva breaker), the costs of a 2-bus system using the proposed breaker are about a stand-off with a 4-bus system using 4.16 kv (250 mva switchgear). (3) Use of 2-stage pumping (series stages), or motors in tandem for driving a boiler-feed pump, aids in designing an auxiliary system with four buses.

(4) Employing split low-voltage winding transformers offers an opportunity for economic gain. (5) Selective throwover of motors during an emergency throwover is a practical method of operation which extends the use of a particular rating of switchgear. (6) Induction-motor contribution to interrupting duty should be considered. Use of the symmetrical ac current calculated at zero time as the current which must be interrupted gives reasonably accurate and conservative results. *AIEE paper No. CP-56-997.*

A new way to simplify the steam power plant. *By H A Kuljian and W J Fadden Jr, The Kuljian Corp.*

Purpose of this paper is to present a new approach to the ever-urgent problem of simplifying the installation and operation of steam power plants. Two alternative methods are involved, both of which combine regenerative feedwater heaters in a single shell. One integrates the closed-type heat exchangers; the other employs a new method of using open-type heat exchangers with intermediate locks. By either method, it is the author's conclusion that a saving in initial investment of from $10 to $15 per kw will be obtained. *ASME paper No. 56-SA-34.*

Avon No. 8—A supercritical pressure plant. *By C A Dauber, The Cleveland Electric Illuminating Co.*

This paper describes the 250,000-kw supercritical pressure addition to the Avon Plant of the Cleveland Electric Illuminating Co. Special features of the unit include use of a monotube once-through boiler, combination motor and turbine-driven boiler-feed pumps, extruded pipe for main steam leads, condenser by-pass demineralization system and a high-temperature-water heating system for the plant addition. *ASME paper No. 56-SA-69.*

Direction for ordering papers on page 220

Nuclear power plants

The homogeneous reactor test mockup. *By I Spiewak and H L Falkenberry, Oak Ridge National Laboratory.*

During design and construction of the Homogeneous Reactor Test (HRT) some of its major components were assembled and operated on unenriched uranyl sulfate solution. A description of this mockup is presented and the operational experience as related to the design and operation of the HRT is outlined.

The authors conclude that the engineering experience with the HRT mockup demonstrates the advisability of operating a simulated reactor system as early as possible in the design and construction stages of a new reactor. Although the need for parallel individual component tests is recognized, some problems cannot be solved or even foreseen in such tests. Also, operation of components in an integrated system gives some indication of what can be expected when one or more items misbehave.

The authors believe that operation of the HRT mockup speeded up the HRT operation by six to twelve months by supplying information on (1) redesign of the pressurizer (2) damping of the float-level controller (3) need for increase of the oxygen concentration.

They presume that component tests would have supplied most of the other useful information obtained in the integrated system. An integrated system diverts parallel development effort into the most profitable channels. The facility can also be of value in training reactor personnel. *ASME paper No. 57-NESC-62.*

Engineering and construction of the engineering test reactor. *By P D Bush, W Malott, H D Young, E A Dukleth, J Finke, W J Dodson, Kaiser Engineers.*

Construction of the 175-mw Engineering Test Reactor (ETR) is nearing completion at the National Reactor Testing Station in Idaho. The ETR facility consists of such major equipment as a reactor, storage canal, primary and secondary coolant systems, experimental facilities, associated buildings, and extensions to existing utilities.

This paper describes some of the problems that have arisen during the course of the project and the solution of which may be of help to others who are about to embark on a program of this type. *ASME paper No. 57-NESC-106.*

Control problems in sodium-cooled graphite moderated reactors. *By J E Owens, Atomics International.*

Data from the Sodium Reactor Experiment (SRE) will be combined with a comprehensive analysis effort to determine optimum operating techniques for the SRE. Future sodium-graphite reactor designs will incorporate the knowledge gained from the SRE.

The earliest series of tests with the SRE will give information on sodium flow transients and on the temperature transients associated with reactor power variations and with reactor scrams. This data will be compared with data obtained from the analog simulator studies which have been made over the past two years. Comparison will enable the determination of the accuracy of the simulator and should allow construction of more precise simulators for future reactors. *ASME paper No. 57-NESC-77.*

Standards and codes

Standard for dry-chemical extinguishing systems, July 1957. *By National Fire Protection Association.*

Some important types of hazards and equipment that dry-chemical systems may satisfactorily protect include: (1) flammable liquids and materials having the same burning characteristics, such as naphthalene and pitch (2) flammable liquids or gases issuing under pressure (3) electrical hazards, such as transformers and oil circuit breakers (4) ordinary combustibles, such as paper and textiles where the fire is likely to be of a surface nature.

The Standards cover total flooding systems, fixed nozzle and hand-hoseline local application systems. *NFPA pamphlet No. 17.*

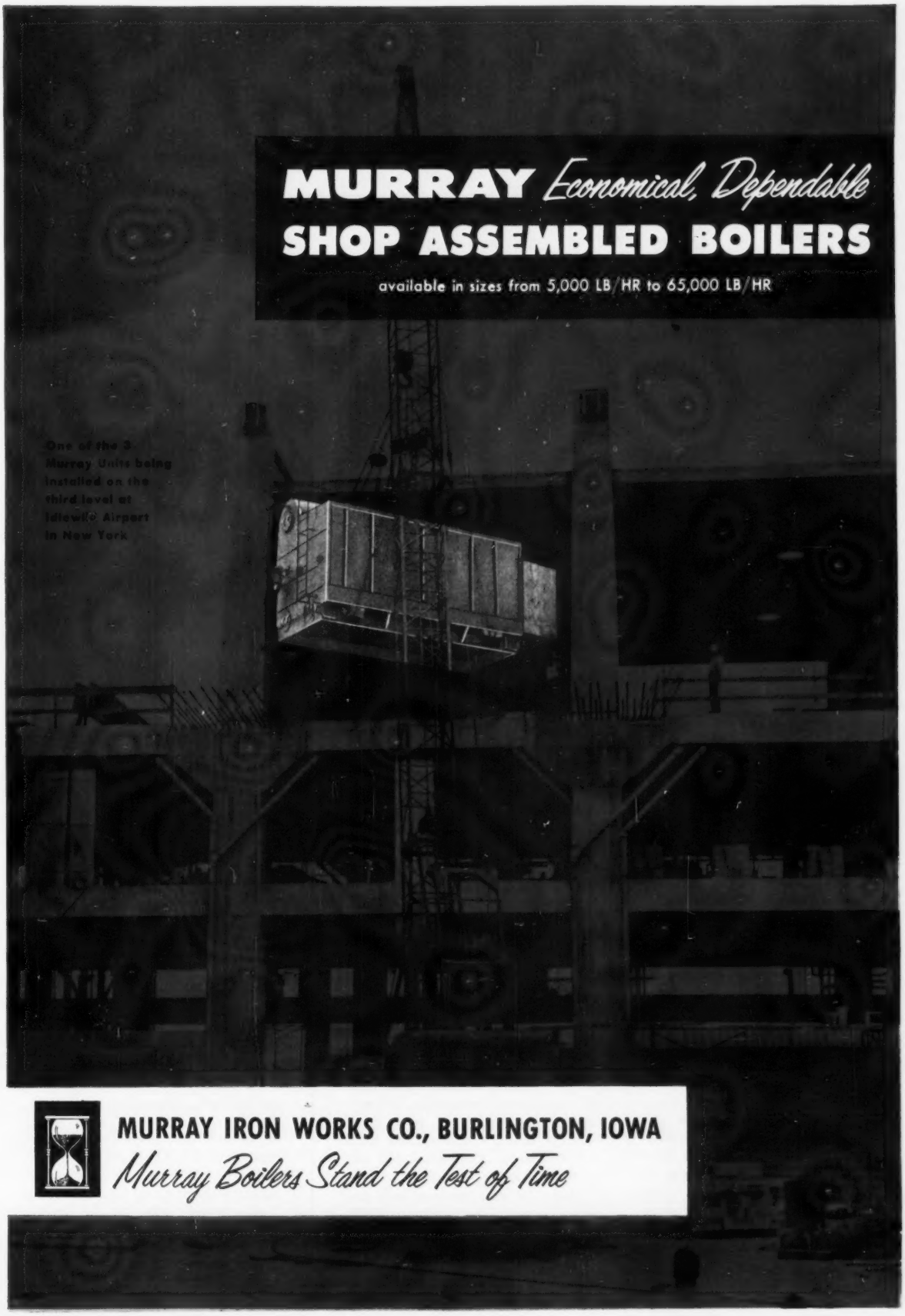
Standard for carbon-dioxide extinguishing systems, May 1957. *By National Fire Protection Association.*

Some of the more important types of

(*Continued on page* 214)

MURRAY *Economical, Dependable* SHOP ASSEMBLED BOILERS

available in sizes from 5,000 LB/HR to 65,000 LB/HR



One of the 3 Murray Units being installed on the third level at Idlewild Airport in New York

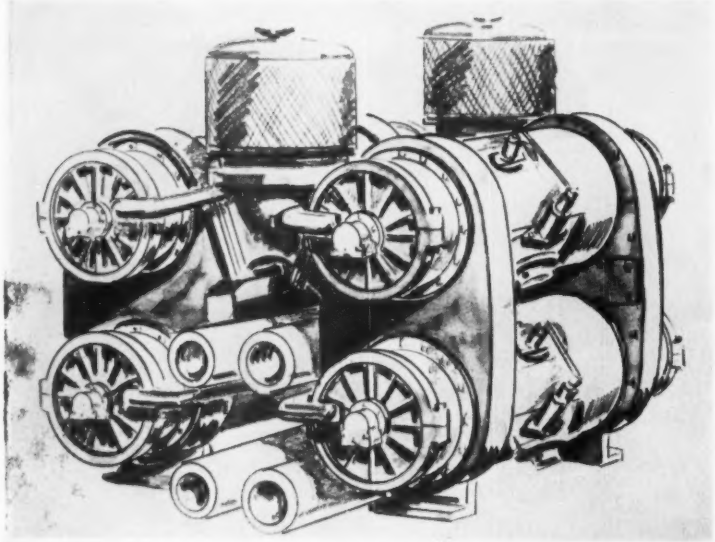
MURRAY IRON WORKS CO., BURLINGTON, IOWA

Murray Boilers Stand the Test of Time

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



GASIFIERS MAY BE COMBINED. This quadruple unit produces 1000 hp

Free-piston engine yields pneumatic power

1001 • Newly designed turbo-charged free-piston engine produces pneumatic power, in contrast with crankshaft engine which produces mechanical shaft power. Pistons are free to bounce in their cylinders. They are restricted by cylinders, but not by linkage through connecting rods, as in crankshaft engine.

Manufacturer claims that engine, adaptable to burning a wide range of fuels, is most efficient fuel user yet developed. Numbered among the promising immediate uses for this engine are stationary and mobile power plants, large tractor-trailer and marine power plants.

Power output ranges from 125 shaft hp, obtained from single gasifier, up to 1000 shaft hp from gasifiers used in multiples. Range is available through use of two types of free-piston engines: single-stage design, designated DL, and two-stage turbo-charged design, FP-165.

DL design uses single-stage compression and patented movable compressor head to produce output of 500 shaft hp. DL units can be combined in multiples with one turbine to reach peak of several thousand shaft hp when turbocharged.

New design FP-165 is two-stage compression unit producing 250 shaft hp with turbocharging, 125 shaft hp without. According to manufacturer, unit combines power-to-weight ratio and torque characteristics of open-cycle gas turbine with the economy and efficiency of a diesel.

Free-piston gas-turbine plant can be made directly reversible, will provide reverse power up to 65% of forward rating. Standardized units can be stacked or combined and connected to the same turbine.

Model DL unit has been built and tested, is ready for production. FP-165 awaits production development.

Baldwin-Lima-Hamilton Corp, Hamilton Div, Hamilton, Ohio

Larger capacity feature of steel shaft-mounted drive

1002 • All-steel shaft-mounted unit is available in single-reduction ratio of 5:1 and in two double-reduction ratios of 144:1, 25:1. Unit ratings range from 2 hp at 5 rpm to 50 hp at 359 rpm; maximum torque rating at low speed shaft is 31,000 lb-in., manufacturer states.

Longer center distance between shafts is said to permit use of larger sheaves on installations where unit is mounted with input shaft toward driven machine or on through-shaft applications. Inspection covers on three-wall one-piece all-steel housing provide easy inspection of bearings and helical gears. Automotive-type dip stick permits quick, accurate check of oil level. Request further details, selection and dimension tables, from manufacturer.

The Falk Corp, Dept 255, 3001 W Canal Street, Milwaukee 1, Wis.

For more data on these items, use the post cards on page 167. Identify your request with item number

Hot Creosote No Problem for Crane Stop-Check Valve

Defies splinters, dirt and grit

Handling hot creosote seems like an unusual application for stop-check valves. And it is!

But this installation points up dramatic proof of Crane quality—and what it means to cost-free operation.

For ten years the Long-Bell Division of the International Paper Company, at Longview, Wash., has had this Crane angle stop-check valve on a hot creosote line from a retort. The valve is operated every 24 hours. Occasionally solids come through—wood splinters, slivers, dirt and grit—and yet this Crane No. 30E 250-pound valve has a trouble-free record clear of any maintenance costs.

Why take chances with your valves—the heart of your flow control system. Be sure: specify Crane valves and fittings from the big, complete, strictly quality Crane line—industry's first choice for over a century.

YOU'LL WANT a copy of "Valve Performance Facts"—32 case histories covering valve installations throughout industry. Contact your local Crane Representative or write Crane Co. at address below.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

More EQUIPMENT NEWS

Begins on page 158

Six practical ways to insure plant efficiency

"Still warm . . . he must have just gone out."

Control center for ac motors

1004 • Unit houses controls for three-phase ac systems at 220 volts (1-100 hp) and 600 volts (1-200 hp). All controls are centralized in one group of stationary interchangeable enclosures, each with a grouping of modular starter units. Units are 90⅜ in. high, 20 in. wide and may be combined in straight-line L-shape or U-shape assemblies. They are available for front or back-to-back mounting of controls in NEMA-1 indoor or NEMA-3 outdoor weather-resistant enclosures. Each has main horizontal 3-phase bus, and 3-phase vertical bus for power distribution.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

Valve regulates gas pressure

1005 • Lubricated plug valve is designed to provide high-pressure gas regulation with minimum pressure loss. Unit is pneumatically controlled, cylinder operated. Advantages of unit, according to manufacturer, include operational ease, favorable flow characteristics, high capacity with low pressure loss, silent regulation and automatic pressure control. Unit is primarily designed for high-pressure large-volume applications. Typical installations include high-pressure transmission lines, storage and town border stations.

Rockwell Manufacturing Co
411 N Lexington Ave, Pittsburgh 8, Pa.

Hydrostatic tester used at the site

1006 • Portable utility-model unit weighs 55 lb and is contained in case which can be carried like an overnight bag, according to manufacturer. It is designed for general industrial use in field-testing valves, pressure vessels, piping, steam generators, pump cases and other process equipment at pressures up to 3000 psi.

Unit is 18x14x8 in. and comes complete with four test-accuracy gages and eight feet of hydraulic flexible tubing which packages on rear of cover. Pump handle folds flat in the case. Tester can be used with water or other hydraulic fluids. Details from manufacturer.

Farris Engineering Corporation
627 Commercial Avenue, Palisades Park, N. J.

Watthour meter has extended range

1007 • Multi-stator unit is said to be first of a line of polyphase watthour meters. Manufacturer claims improved electrical and mechanical characteristics for socket-type two-stator meters and extended load range resulting from use of slow full-load speed of 8 1/3 rpm. Reduction in height permits use of single-phase cover.

Meter registers voltage variations to 125% without special calibration. This feature permits use of 240-volt meters on 120/208, 240/416 and 277/480 volt network systems. Design features are said to be: ease of assembly, accuracy, stable calibration and good visibility.

Sangamo Electric Co
11 & Converse Sts, Springfield, Ill.

Control keeps air volume constant

1008 • Constant-volume controller is designed for use with high-velocity high-pressure double-duct air-conditioning systems. According to manufacturer, unit provides constant-volume air distribution through every part of system, maintaining a constant flow pattern within each conditioned space. This is accomplished, according to company engineers, regardless of number of mixing units, length of duct runs or differences in pressure between hot and cold ducts. Unit is preset for desired rate of air delivery, eliminating manual balancing. Objectionable variations in sound level have been eliminated.

Johnson Service Co, 509 E Michigan St, Milwaukee, Wis.

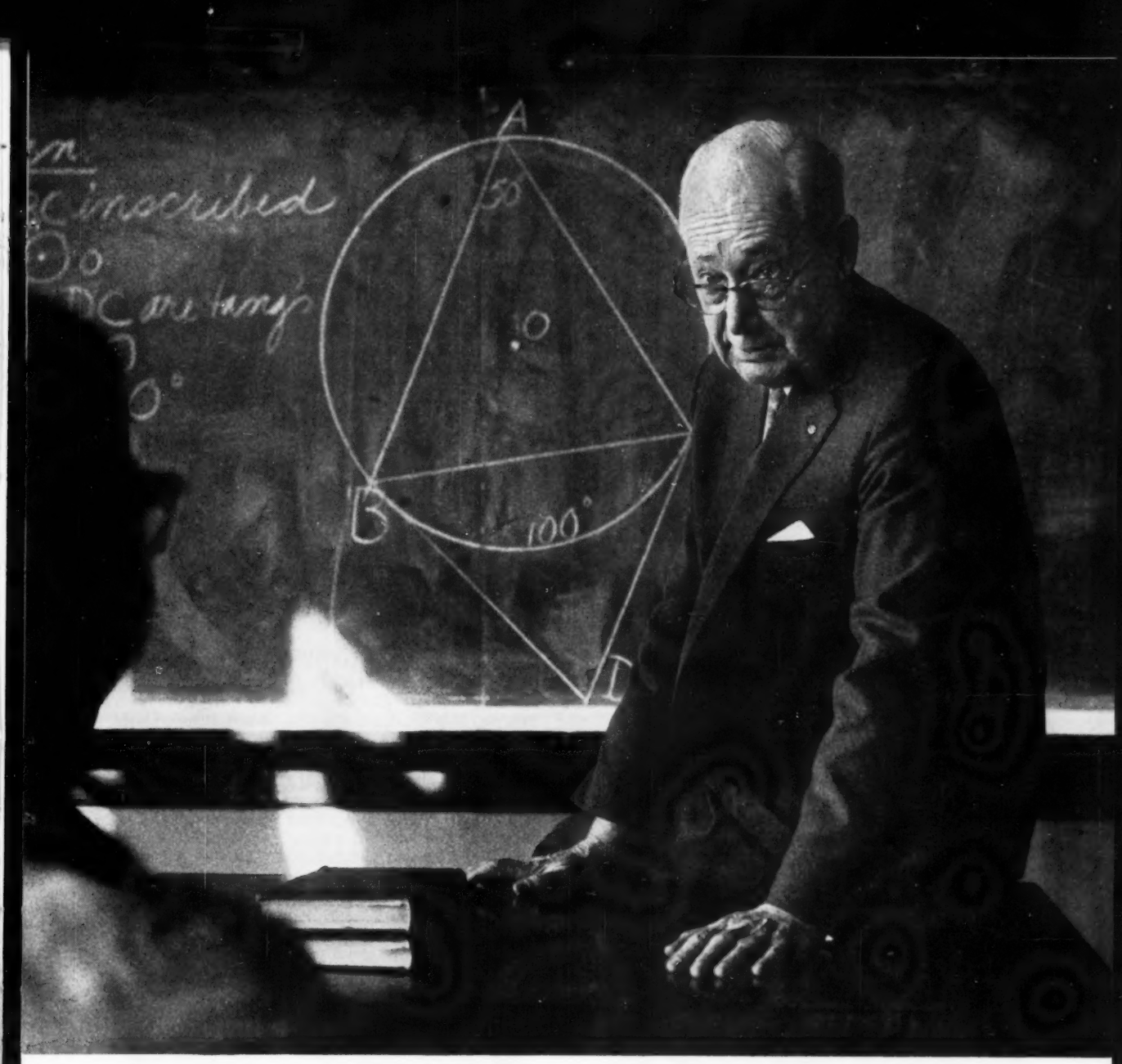
Fluid-flow meter has new design

1009 • Mercuryless meter uses reformed highly sensitive diaphragms stacked together for positive overrange protection to full static pressure. Each pair of diaphragms, forming low-pressure and high-pressure diaphragm elements, is welded together at outer circumference, and to opposing faces of spacing rings at inner circumference. Unit compresses under pressure to prevent overrange damage, according to manufacturer.

Differential ranges are 0-20, 0-50, 0-100, 0-200 in. of water. Meter comes in rectangular or circular case, yoke or flush mounted and is available for 2000-psi service.

The Foxboro Company, Foxboro, Mass.

For more data on these items, use the post cards on page 167. Identify your request with item number

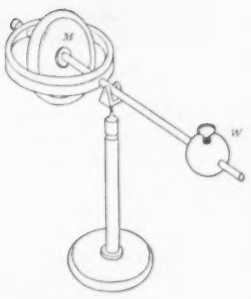


A Teacher affects eternity... he can never tell where his influence stops

... wrote historian Henry Brooks Adams—a truth that today demands universal recognition. America is losing to industry many of those best able to inspire and mold youthful minds—the dedicated teachers of high school subjects prerequisite to engineering training.

The value of a teacher's influence in a boy's selection of a career cannot be over-estimated, yet all too often the rewards of teaching are more spiritual than material. Compensation fitting the importance of their work can help keep teachers in their classrooms, where they prefer to be.

America gains every time teaching is chosen as a career. It also gains whenever a teacher finds it possible to remain in the profession.



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ENGINEERS AND BUILDERS FOR INDUSTRY

SAN FRANCISCO • Los Angeles • New York • Houston

CANADIAN BECHTEL LIMITED

Toronto • Vancouver

More EQUIPMENT NEWS

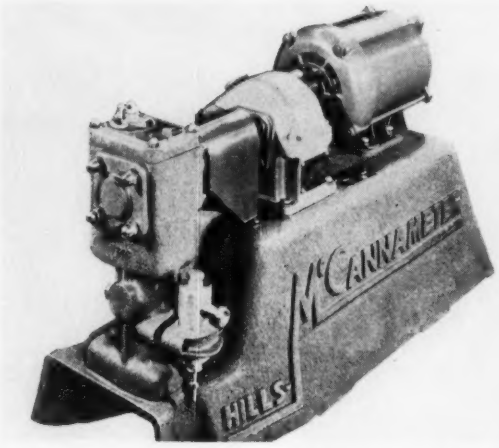
Begins on page 158

Nickel alloy protects mild steel

1010 • Low-cost method of nickel-alloy cladding is said to provide corrosion resistance, increase service life of ferrous tubing and pipe. After application, coating is heat-fused in a reducing atmosphere, forms bonded interface with base material which resists scaling, even when base is bent to 180 deg.

According to manufacturer, cladding provides heat protection to 1150 F, may be welded without loss of effectiveness. Average protective coat is .001 in. thick, but up to .025 in. coat may be applied at one time. Further applications provide resurfacing for worn base metal.

Tube Reducing Corp, 534 Main Ave, Wallington, N. J

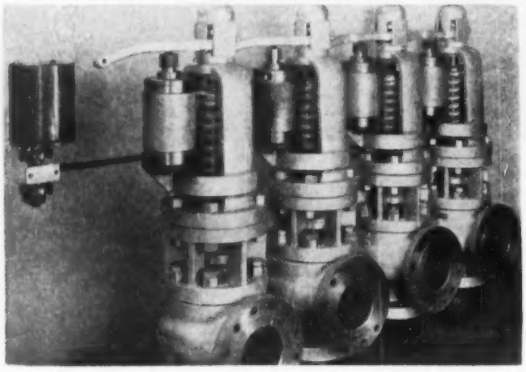


Teflon adds to pump service life

1011 • Packless diaphragm pump for proportioning and metering fluids is said to perform at pressures up to 2500 psi. Unit has diaphragm of solid Teflon permanently bonded to and covering elastomeric backing. Length of service is increased by combining chemical resistance with flexibility, it is claimed.

Pump incorporates features such as packless design, capsulated construction, minimum maintenance and continous flow in a wide output range; performs well in field tests according to manufacturer. Complete technical information available from manufacturer.

Hills-McCanna Co, 2369 W Nelson St, Chicago 18, Ill.

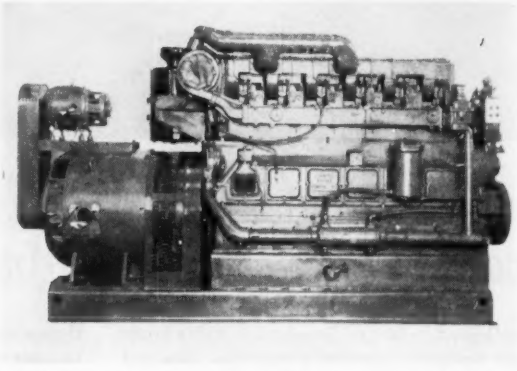


Valve features air-lift cylinder

1012 • Spring-loaded valve insures protection against overspeed of low-pressure turbine by addition of air-lift cylinder. In case of intercept valve failure, cylinder is said to lift valve to full discharge capacity at any pressure down to zero in 1/10 sec.

Over-speed switch on turbine activates mechanism immediately when over-speed takes place, relieves pressure in header to remove cause of danger. Request details.

Crosby Valve & Gage Company
Kendrick & Depot Sts, Wrentham, Mass.



Higher hp produced by heavy engine

1013 • Slow-speed engine now provides 450 hp for pumping units, electric power generation, other heavy industrial work. Turbocharger develops extra hp: turbine located in exhaust system drives centrifugal blower in air intake system, forces greater weight of air into cylinders to burn fuel more completely, manufacturer claims.

Engine has rating of 450 hp at 1100 rpm, displacement of 2477 cu in. LRT-6 industrial unit is 99 5/16 in. long, 39 5/16 in. wide, 58¾ in. high, weighs 7690 lb.

Cummins Engine Co, Fifth & Union Sts, Columbus, Ind.

For more data on these items, use post cards page 167. Identify your request with item number.

Kill Algae

Get SAFE, QUICK CONTROL at Low Cost

Allis-Chalmers No. 120 Series Algaecide eliminates fouling of cooling tower systems by algae and slimes

Check the many exclusive advantages of Allis-Chalmers No. 120 Series algaecide:

- Easy to introduce into the system by means of pump, drip feed or manual feed. No expensive feeding equipment required.
- Safe to handle. Even in concentrated form, it is no more than a mild irritant to skin, eyes and mucous membranes.
- Low toxicity to fish or animals.
- Non-oxidizing.
- Inhibits corrosion.
- Dosage is independent of organic, ammonia, or nitrogen content of makeup water.
- No loss on passage through tower.
- Proved effective in field use.
- Only 2 to 5 ppm required for effective dosage of most organisms.

This is the most effective algaecide known. If you have a problem with plugged pump strainers, coated heat exchanger tubes, coated slats in cooling towers, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 28X8434.

ALLIS-CHALMERS

A-5442

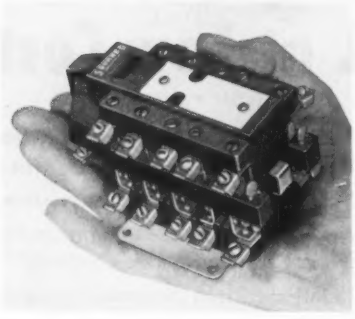
More EQUIPMENT NEWS

Begins on page 158

Enclosed motor gains hp

1014 • Unit, available in NEMA ratings up to 50 hp, features rugged but compact construction and uses 46% less space, according to manufacturer. Cast-iron motor has dripproof design, two-way ventilation for uniform cooling, asbestos insulation and solid-cast rotor. External parts are made of cast iron, including split-type outlet box.

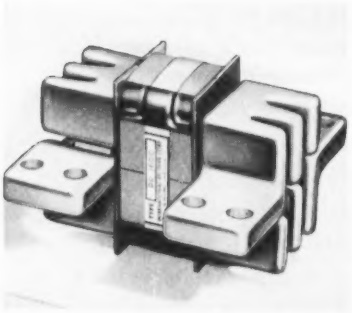
U.S. Electrical Motors Inc
200 E Slauson, Los Angeles, Calif.



Relay has 10 contacts

1015 • *Type-D* 10-amp relay comes in 10-contact size, with a maximum of six normally-open and four normally-closed or eight normally-open, two normally-closed contacts. Unit measures five in. high by three in. wide, a valuable feature if panel space is at a premium, according to manufacturer. Unit is easily interchangeable with others in series. Ask details from manufacturer.

Square D Company
4041 N Richards St, Milwaukee, Wis.



Reactor rated at 1600 amp

1016 • *PR-1600* paralleling reactor is used to equalize current distribution to selenium stacks, germanium and silicon rectifiers operated in parallel, variable transformers, adjustable reactors and rheostats. Unit is second of series of paralleling reactors and is rated at 1600-amp rms for 50-C temperature rise, with normal cooling.

International Rectifier Corp
1521 E Grand Ave, El Segundo, Calif.

Channel-wedge insulation

1018 • High - temperature insulating units are graduated to fit slots of most motors. There are 36 styles available in widths from ⅛ to ½ in. with half round or flat contours. Wedges have slightly tapered sides for fit.

Units are laminated from woven-glass cloth impregnated with high temperature resins; silicone for Class H, polyester for Class B. Advantages listed are strength and space-saving.

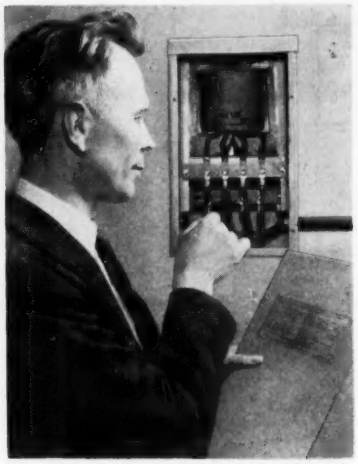
Silicone Insulation, Inc
1383 Seabury Ave, Bronx 61, N. Y.

Film-coated magnet wire

1019 • This is said to be first polyester film-coated magnet wire to be offered under 155-C rating established by AIEE. It is said that wire's high level of thermal stability makes it particularly applicable to motors, transformers and electronic equipment.

Manufacturer claims it is designed to give greater thermal and chemical stability, excellent abrasion resistance and dielectric strength. Request details.

Anaconda Wire and Cable Co
Muskegon, Mich.



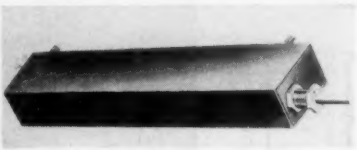
Class H dry transformer has removable front panel

1017 • Unit is available for lighting applications in circuits of 600 volts and less.

Feature of unit is removable front panel which is said to make clamp-type terminals accessible for neat, quick wiring. Using grain-oriented core steel, core and coil are elastically suspended for quiet operation. Units are said to have exceptionally low exciting current. Also said to have high temperature resistance, moisture resistance and chemical stability. Operating temperatures allow normal cable entrance.

R E Uptegraff Manufacturing Co
299 N Lexington Ave, Scottdale, Pa.

Don't miss this item . . .



Delay line . . . . . **p 206**

. . . or other product news appearing on following pages

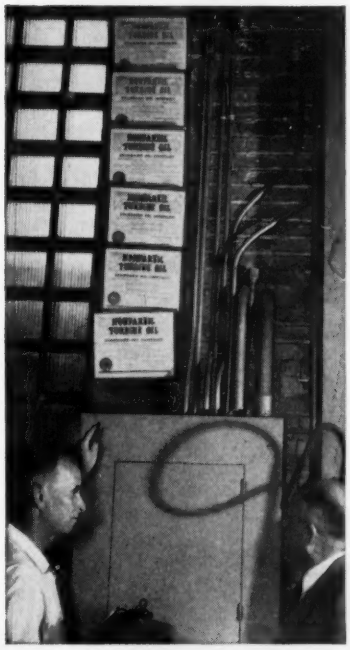
Plug-in circuit breaker . . . . . **p 206**
Damper opener . . . . . **p 209**
Boiler scaffold . . . . . **p 209**
Gate valves . . . . . **p 210**
Flexible couplings . . . . . **p 210**
Mixer-disperser . . . . . **p 213**
Danger-signal bull plug . . . . . **p 213**

For more data on these items, use the post cards on page 167. Identify your request with item number

They packed up turbine oil worries at Alton Box Board

six turbines use NONPAREIL Turbine Oil, have life-of-turbine guarantee

Six NONPAREIL Turbine Oil guarantee certificates on the turbine room wall are pointed out by M. D. Jones, Superintendent of the Power and Steam Department. Standard Oil Company's lubrication engineer, W. P. "Sandy" Wehking, helped put most of the certificates there.



Alton Box Board Company, Alton, Illinois, doesn't have a worry in the world about turbine oil. The Company has six turbines in service—four in the power plant and two in the paper mill—all using NONPAREIL Turbine Oil. Why no worries? Because each of these fills of turbine oil is *guaranteed for the life of the turbine* not to exceed a neutralization number above 0.15 mg. KOH/g.

The five Westinghouse and one G-E turbine oil fills have demonstrated a remarkable low acidity record over the years. Regular inspection by Standard Oil technical service representatives and analysis of oil samples by the Standard Oil Research Laboratory, Whiting, Indiana, makes sure the oil is performing in accordance with the guarantee. At Alton Box, neutralization number of the oil has been running 0.02 to 0.03 mg. KOH/g.

This is what such service from a turbine oil means to Alton Box Board: They can run one of the largest board mills in the world without having to concern themselves with the performance of the turbine oil they are using. Standard Oil technical service men inspect the system. The oil is sampled and analyzed regularly. Plant operation will never be interrupted because of turbine oil lubrication failure.

The same performance from NONPAREIL Turbine Oil and service from Standard Oil awaits you. Find out. Call your nearby Standard Oil office near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

How NONPAREIL Turbine Oil is performing at Alton Box Board

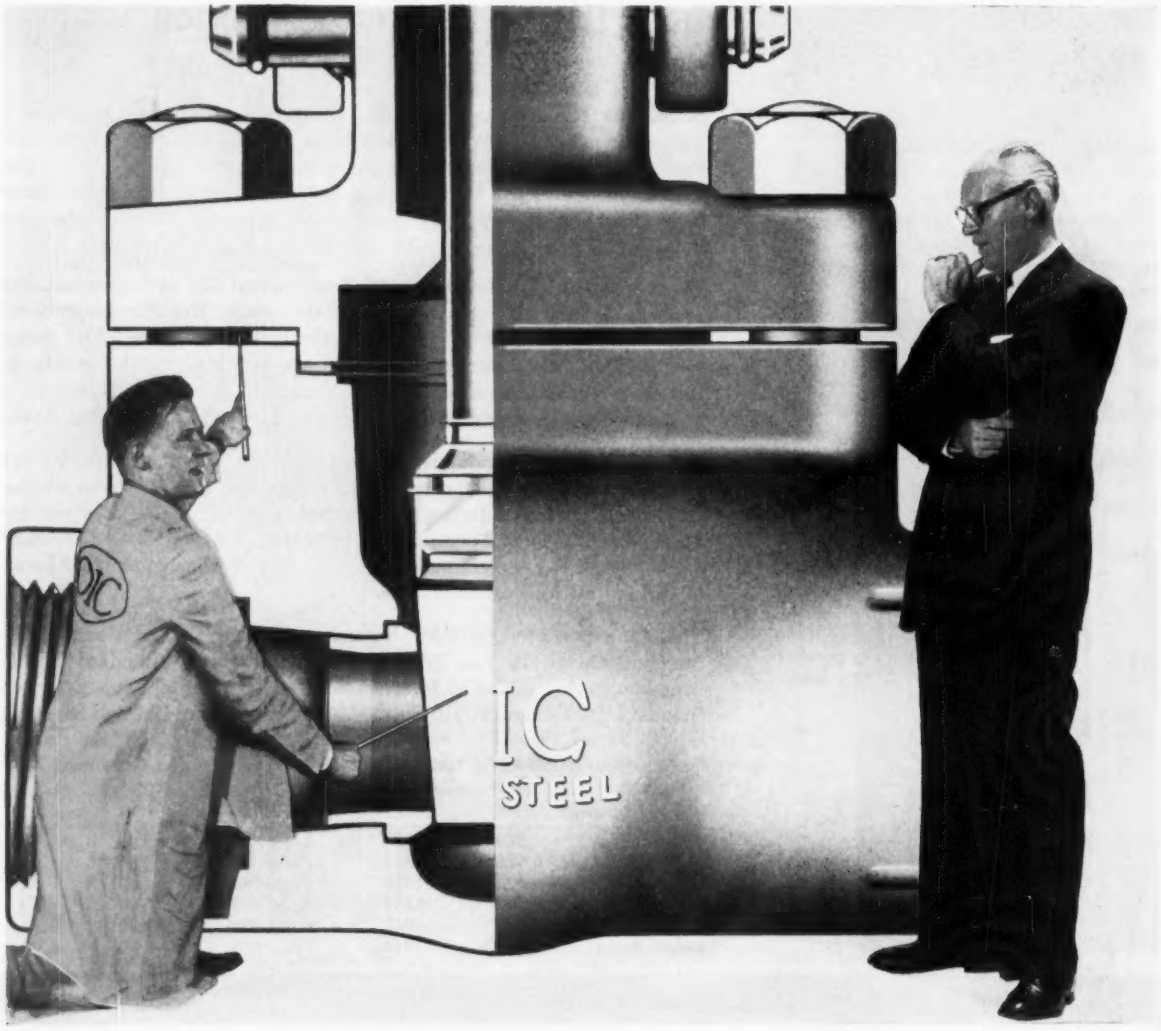
Make of Turbine	kw. (H.P.)	Year NONPAREIL Installed	Location	Gal. fill.	Neut. No. mg. KOH/g.
Westinghouse	1,500	1934	Power Plant	85	.02
Westinghouse	3,125	1936	Power Plant	275	.03
General Elec.	400	1936	Paper Mill	50	.02
Westinghouse	1,500	1941	Power Plant	250	.03
Westinghouse	5,000	1947	Power Plant	230	.03
Westinghouse	1,500	1947	Paper Mill	80	.02

Discussing lubrication. Sandy Wehking, Standard's man on the Alton Box Board account, is well qualified to do so. He's been at this work for 15 years. Sandy studied chemical engineering at Blackburn College. He has also completed the Standard Oil Sales Engineering School.

STANDARD

STANDARD OIL COMPANY
(Indiana)

...and you can see here....and here, sir, how we've killed maintenance problems on our new forged steel lines.



We stop galling and erosion by giving you 13% chrome stainless steel trim with wedges *duracased* to a rugged *1000 Brinell hardness.*

The square and *bolted* body-bonnet joint makes it easy to service the valve quicker. And it's a tighter joint, made doubly leakproof by recessing the soft iron gasket into the body. The gasket can't blow!

And you get the fastest joint make-up you've ever seen. Look at those pipe ends. See the extra wrench-gripping area and lugs. See how body-bonnet flanges are out of the wrench's way. No time lost here!

These new 600-lb. OIC forged steel valves are available with either *high-flow* ports (1300 line), or *standard-flow* ports (1100 line). Call your OIC Distributor, or write for specification literature.

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AIR CONDITIONING, HEATING, REFRIGERATION, VENTILATION

1 **Air filtration** is subject of 6-p illustrated booklet. Includes performance and selection tables, construction and installation data. Flanders Filters Inc, Box 718, Riverhead, N.Y.

2 **Air conditioning** and distribution control are discussed in illustrated 4-p booklet F-8326. Contains descriptions of types of systems available, complete listing of field offices. Barber-Colman Co, Rockford, Ill.

3 **Centrifugal roof ventilators,** belt and direct drive, are described in 12-p bulletin SDA-220. Lists features, construction details, ratings. Performance data and dimensions, recommended specs are included. The Peerless Electric Co, Fan & Blower Div, Warren, Ohio.

4 **Industrial burner** catalog lists gas, oil, combination-firing units, from 4000 to 60,000 pph steam. Includes photos of installations. Coen Co, 40 Boardman Place, San Francisco 3, Calif.

5 **Unit heaters** are described in 26-p illustrated booklet B-1523. Design features are detailed and illustrated. Construction, application, capacity tables are given. Contains diagrams, installation data. Westinghouse Sturtevant Div, Dept T-333, 200 Readville St, Hyde Park, Boston 36, Mass.

BOILERS AND AUXILIARIES

6 **Feedwater heaters** are subject of 4-p bulletin 150. Illustrations and diagrams are included, features are discussed. Hoppes Manufacturing Co, Springfield, Ohio.

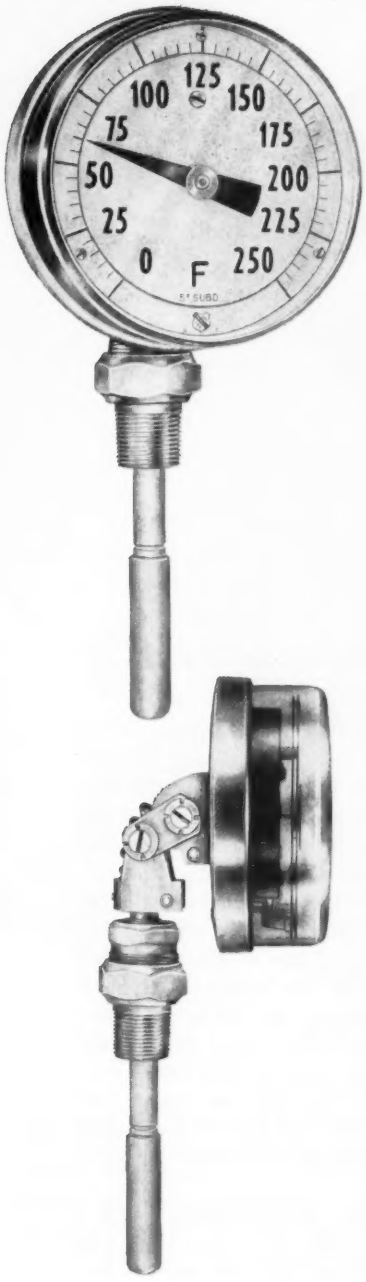
7 **Steam generator** with fire-tube packaged design, 3-pass design with gas vent in rear, is discussed in catalog 56A. Lists standard and optional equipment, contains table of significant data. Also includes detailed diagram of generator. Erie City Iron Works, Erie, Pa.

8 **Automatic boilers** for steam or hot-water heating and hot-water service are subject of 4-p illustrated bulletin 1243. Packaged boilers in 15 to 25 hp for pressures up to 15 psi are listed. Includes tables of dimensions, weights and ratings. Orr & Sembower, Inc, Reading, Pa.

9 **Refractory** for steel mills and foundries is described in illustrated 4-p bulletin 872. Applications and instructions for use of plastic fire brick are included. Refractory Dept, Denver Fire Clay Co, 2301 Blake St, Denver 5, Colo.

COMPRESSORS AND ACCESSORIES

10 **Steam-jet exhausters** and compressors are treated in 8-p bulletin 4E. Includes application, construction. (*Continued on page* 200)



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George Edwards

meets a communications expert

► OUR TEEN-AGE SON spent the past summer working on a dairy farm on the edge of Lake Champlain up in Vermont. About a month after he'd gone, we got a glowing letter about the fishing, swimming, farmer's wife's cooking, etc. Not a word about work.

He'd gotten the job through his high school counselor and I remembered some mention about 35 cows. A country boy myself, I knew that even with today's mechanized equipment, there's more to do than just say hello to the cows once in a while. So during my vacation in August, Mrs Edwards and I drove up that way.

We found him working hard and in great shape. But he hadn't expected all the fun he was having and it was all he could think of when he wrote home—a reaction I didn't mind at all.

On the way back through Albany I looked up Harry Fenwick, a plant engineer I hadn't seen for a couple of years. I met his boss, Plant Manager Walter Thurston, and the two were nice enough to take me on a quickie tour of their plant.

Going through the place I was struck by the air of friendliness. The men seemed genuinely glad to see Harry and Walter, who called practically everybody by his first name. I was more impressed when I learned that Thurston had been transferred to that plant less than a year before. I said as much as we had a cup of coffee in his office.

"Charge it up to communication," laughed Walter, "and I don't mean telephones or written orders.

"One of the first jobs I ever had was electrician's helper. I also helped clean boilers and did other odd jobs. There weren't any unions in those days. I didn't mind working, but I sure hated not knowing what I'd be doing from day to day and often not knowing why I was doing a certain job.

"One day a foreman told me to get a shovel and come along. Outside the boiler house he marked a spot with his toe and told me to dig a hole. I dug down about two feet when he said never mind, dig one over here. He didn't like that one, so I dug another, then two more. When he marked another spot, I told him to dig his own blankety-blank holes and walked away. During the following hassle, which nearly cost me my job, I found that we were trying to find a buried water line that hadn't been used since a small building was torn down a few years before. If the guy had had brains enough to tell me what we were after, I'd have dug holes all night for him.

"I made up my mind then and there that if I ever had men working under me, they'd know *why* they were doing a job and that they were an important part of it. The success of any job depends on the whole team knowing and understanding the signals."

Later, as Harry walked to the car with me he told that their employee-turnover problem was almost zero, and it was a plant joke that the grievance committee's grievance was that they had nothing to do. But it was no joke that they liked it that way.

"Walter's way of doing things," said Harry, "started a sort of chain reaction around here. It's something that doesn't cost the plant a nickel, but I'd sure like to have the money it saves. And I think a large dose of the same thing could cure a lot of plant problems across the country."

"PHE" COMPRESSOR

serves growing plant-air load at Rotary Electric Steel Co.

WHEN the Rotary Electric Steel Company of Detroit, Mich., increased plant capacity, the existing plant-air supply was also increased by adding the Ingersoll-Rand 100-hp PHE compressor shown above. The extreme simplicity of this installation is obvious at a glance.

The main air supply consists of two Ingersoll-Rand duplex, electric-driven compressors totaling 500 hp. After serving for 40 years they are still giving entirely satisfactory performance.

The new PHE unit is a compact, packaged-type, two-stage air compressor with built-in motor and efficient intercooler. It was shipped completely assembled, ready to run. Installation was simply a matter of mounting the unit on a small foundation and connecting the air, water and power lines. And like many other modern Ingersoll-Rand compressors the PHE has full-floating aluminum bearings that need no adjustments.

Ask your I-R representative for full details on the smooth-running PHE compressor. Its inherent longevity and low maintenance requirements mean big savings in air power costs.

Only I-R Compressors have CHANNEL VALVES

Known the world over for High Efficiency • Quiet Operation
Durability • Air-Cushioned Action • Corrosion-Resistance
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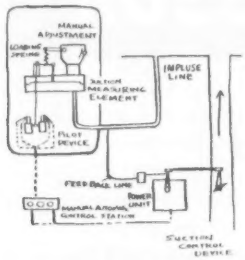
RAMBLINGS ON INSTRUMENTATION

The lowdown on boiler plant control systems—Chapter 4

Last month we talked about combustion control systems in general . . . now let's get ~~commercial~~ specific and talk the operating advantages of Hays Electric Combustion Control.

Among other things, a major point is the characteristics of electricity itself. When an impulse is given to a power unit, for instance, the signal travels at the speed of light. For those interested, this is 186,000 miles per second (on clear days).

As an example of how this electricity is used in a typical control problem, please direct your attention to this version of a furnace draft controller as rendered by our staff artist Picasso O'Toole:



Perceptive readers will note that the actual draft or negative pressure to be controlled acts upon a slack type diaphragm sensing element located within the controller. The impulse is carried to the controller from the point being measured by means of a ½" or so black iron pipe (available from Sears, Montgomery Ward or your nearest plumbing supplier). The action of the draft upon the diaphragm is opposed by the loading spring, an adjustable unit, simply set. Through direct linkage, one of two sealed magnetically operated mercury switches is closed, operating the electric power unit directly. The power unit moves until the draft again reaches the value for which the controller is set.

This Hays power unit, by the way, is quite a versatile pile of gears and castings. Electrically operated it has exceedingly high starting torque furnished by a fully enclosed capacitor type motor with no brushes, slip rings or commutators. Special insulation is used so that the power unit can be installed in a high ambient temperature. It can be stalled for several minutes without injury, and it's equipped with overload protection and adjustable limit switches. Finally it can be operated manually by simply flipping a switch at the manual—automatic control station located on the controller itself.

If you're the heckling type, and are still with us, you might be tempted to ask a couple of embarrassing questions. For example "Does Hays really know the technology of Combustion Control?", and "Where have Hays Control Systems operated and how well?"

Our learned engineering vice presidents have assembled a series of technical monographs to answer question number 1 above. If you want the real lowdown just ask us for any of these titles:

1. Steam pressure control. Pub. 965-105
2. Automatic combustion control for spreader stokers. 973-108
3. Automatic combustion control for oil burners. 971-111
4. Instrumentation and controls for small steam plants. 968-113
5. Automatic control applied to measuring and controlling air flow in boilers. 974-114
6. Combustion controls for multiple fuel firing. 1101-269
7. Combustion and combustion guides.

To prove the equipment works, we've gotten permission from some of our good customers to print up booklets describing the results obtained in their plants. These include:

1. Baldwin Locomotive Works—three 16,000 PPH boilers at 300 psi, pulverized coal firing
2. A. B. Dick Company—three 25,000 PPH boilers at 125 lbs., stoker gas fired
3. American Tobacco Company—three 25,000 PPH boilers at 90 psi, stoker
4. Sunshine Biscuit Company—one 30,000 PPH boiler at 1500 lbs. oil fired

So, if you want any further proof (or if you'd like to get mail) just drop us a line. Next month we'll go into the story on combustion guides.

Phil Sprague Jr.

President

THE HAYS CORPORATION • MICHIGAN CITY, INDIANA

MARMADUKE

Continued from page 146

scrap if you can make work. Then I trade in shrimp, also keep cold storage. I give you plenty money. Then I sell icehouse for big money when she OK and give you big cut . . . maybe one grand, OK?'

"'First show me the plant,' I answered. 'Then I'll let you know if I care to sweat my brains out in this superheated corner of the world.'

"'You make work plenty good,' laughed Hung. 'If made of iron, you can do . . . I know, I know.'

"Next morning I met Hung in the lobby of the Malibar Hotel. We took a gharri and after twenty minutes stopped at a run-down wooden joint with a long tin shed near some old boat landings on Beira Lake. The place was deserted and looked haunted.

"Stepping into the machinery shed, I saw two ancient CO_2 refrigeration compressors. There were pieces of machinery and piping spread around the floor. The machines looked like they had been torn out of some old ship's plant. They were high-pressure single-stage jobs and were junk, just as Hung had said.

"Not only were they shot; they were poorly mounted besides. My job was to see if I could get them shipshape again; and keep them working so the cold stores wouldn't spoil. I kept shaking my head as I looked at that mess. Hung, patting me on the back, said 'No forget, one grand plenty money.' And it was! In those days an assistant marine engineer made around $150 a month.

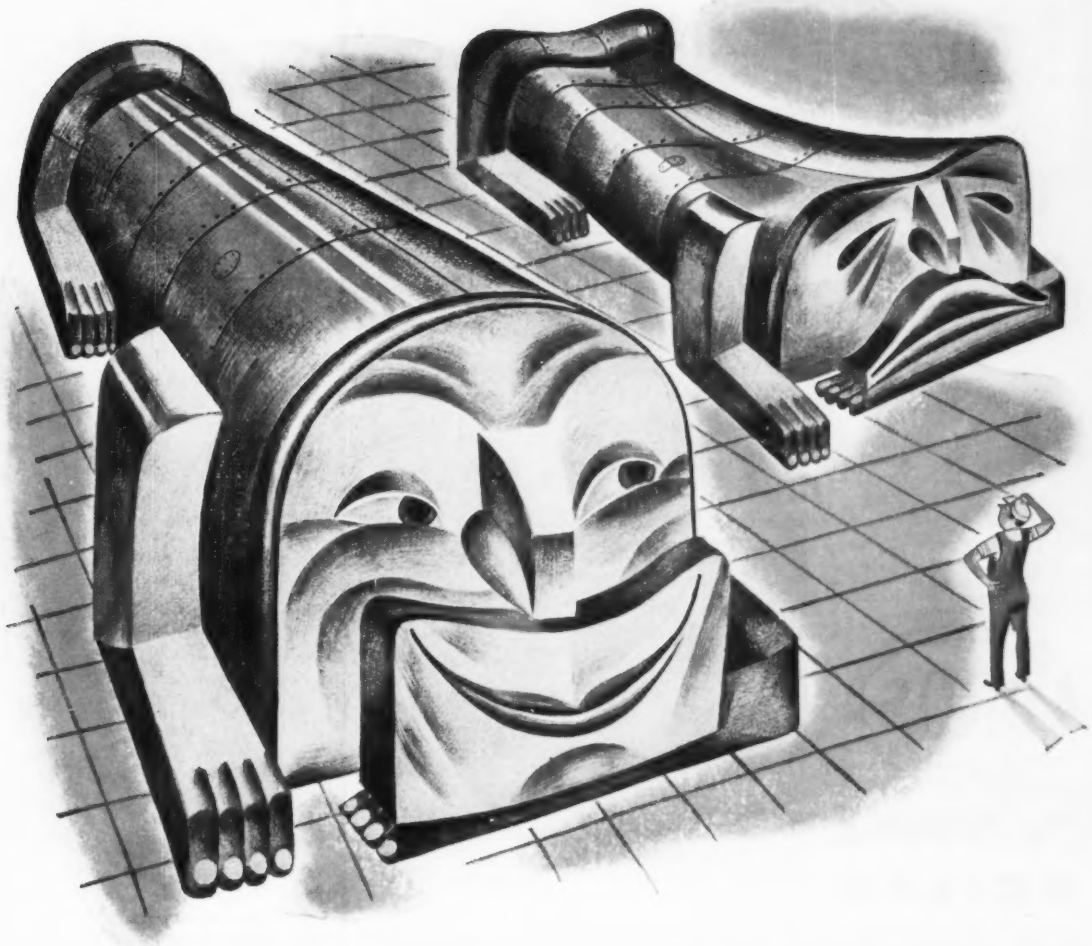
"'OK,' I finally said, 'Can do.' Hung left to close the deal, while I looked around to get my bearings.

"That evening I went aboard to pack my sea bag, then came back ashore. Next morning I showed up at the icehouse, ready to do my stuff.

"First I hired a Portuguese mechanic —Charlie Pereira. He had worked at the plant before. He told me the Dutch Eurasian engineer who installed the compressors was a rum-dum beachcomber with a marine license. He had opened the system for repairs and then was given the heave-ho by the old owner. That's when the place went bankrupt. After a few months the damp climate filled the piping with wet rust.

"The plant was a combination direct-expansion job for cold storage and brine system for ice making. Pereira told me that the Eurasian chief had made plenty of cumshaw from spoiled stores in those storage spaces.

"First I tackled the wet rust. I couldn't get it all out. But since Hung had already made a deal for some cold



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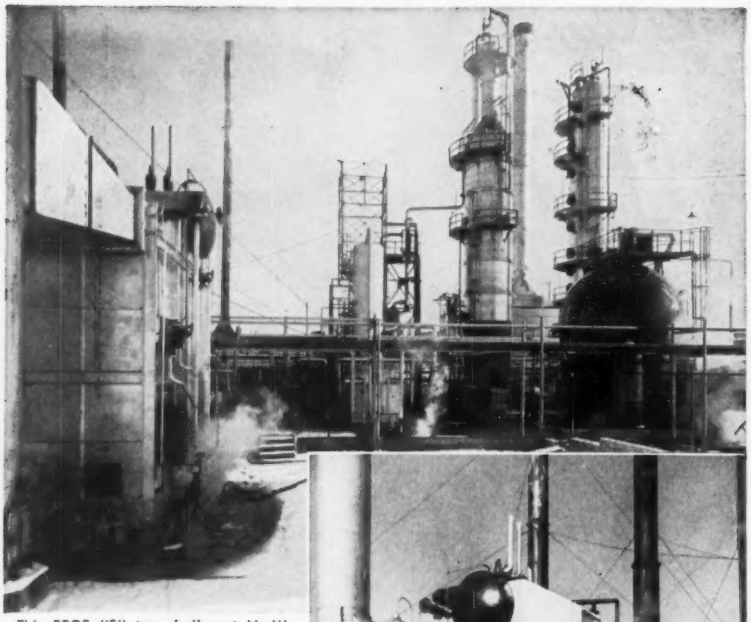

This BROS "S" type boiler at N. W. Refining Co., easily handles steam requirements winter or summer, regardless of ambient temperature.

BROS

"S" TYPE BOILER

Outdoor Installation Provides Dry Steam at 20° Below

Winter, summer, rain or snow this BROS "S" type boiler is providing dry process steam "around the clock" for Northwestern Refining Company, St. Paul Park, Minnesota, refiners of high octane gasolines and other top quality petroleum products.

Designed for Expansion

The boiler is designed for a pressure of 250 psig; at present it supplies the refinery's steam requirements for process and heating, at 125 psig. It is installed on a special steel base so that if the needs of the refinery change, the boiler can be moved in one piece to any desired location.

Outdoor Installation

Built completely within an insulated steel case, the boiler is installed outdoors, and maintains the load as easily at 20° below zero as it does at 100° above. It provides dry steam for heating buildings, oil tanks, tank cars, etc. With a capacity of 30,000 lbs. of steam per hour and 50° superheat, the flexible steam requirements for a refinery are easily accommodated.

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The boiler is fired by 4 combination gas-oil burners. It operates with natural draft using a 150 ft. stack. It is currently being fired with fuel gas from Northwestern's catalytic cracking unit.

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BROS "S" type boilers provide *high efficiency, low maintenance costs, minimum space requirements and simplified installation.* Capacities range from 10,800 to 50,000 lbs. per hr. with design pressures up to 600 psi.

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MARMADUKE

Continued from page 172

storage that was due next week, I started the plant anyway. The rust left in the system played hell with the hard babbitt packing. And each time the packing failed it chewed up the compressor rod.

"To make things worse, both machines were badly out of line. That didn't help the packing either. Trying to hold around 1000 psi of CO_2 in compressor cylinders is tough enough with good machines, but the combination of rust, misalignment, high cooling-water temperatures, poor native help and the hot climate was enough to start me beachcombing, too.

"I solved the packing problem by lining up the compressors. Then I partly licked the rust problem by making soft lead rings and replacing the harder white metal. It took a lot of sweating, but after a few weeks the machines settled down and worked fairly well. Soon their efficiency started to climb.

"One day, Hung dropped in with a Parsi distiller from over near the dockyard. The distiller jobbed carbon dioxide and chemicals on the side. Hung tried to sell him the plant. It ended with Hung ordering a dozen bottles of CO_2 that I needed anyway. The Parsi said he'd think it over and come back in a few weeks.

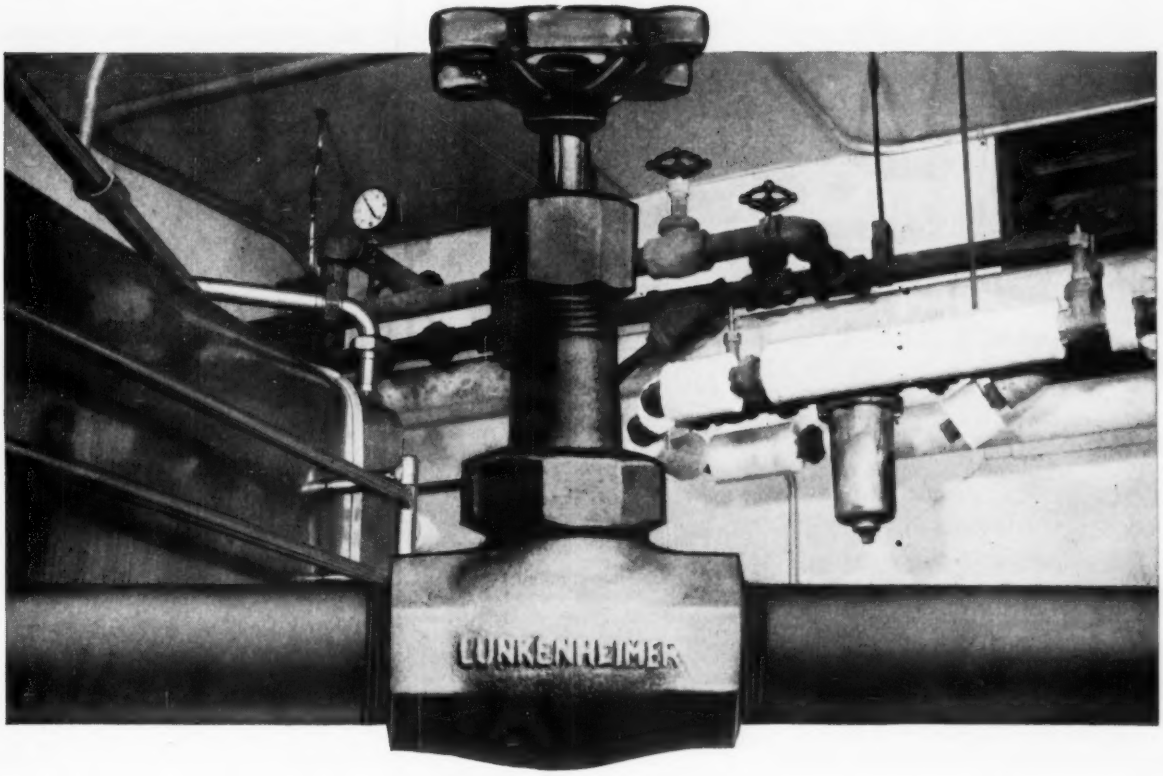
"By then our struggle with high cooling-water temperatures was gradually won. That let me cut out the precooler, which was a temperamental junk heap that loved to dump liquid refrigerant back into the compressor. She did that regardless of how often I overhauled the float gear. The float gear was half shot, but we never had enough time or tools to rebuild it. Besides, Hung kept the storage rooms filled and soon was starting to do a thriving ice business.

"Finally, after six weeks of sweat and emergency calls at all hours of the day and night, the plant started running something like it should. Hung brought in the Parsi distiller for a second look. The machinery was running fine. And business was good because Hung had lined up the biggest Arab merchants and taken some trade away from the Ceylon Cold Storage, Ltd, an English firm.

"Next day Hung and the Parsi were around again, haggling over terms. The Parsi argued that the plant and machinery weren't reliable. He wanted some assurance that he wouldn't have the same experience as the former owner.

"Hung claimed I had completely rebuilt the equipment, and that everything was like new, but the Parsi

ONE ANSWER
to spiraling maintenance costs



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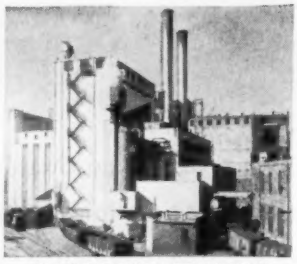

JOS. SCHLITZ BREWING COMPANY
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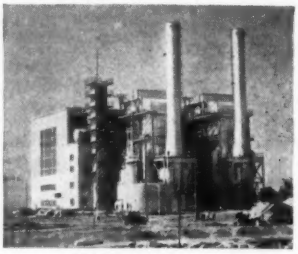

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MARMADUKE

Continued from page 174

wouldn't buy that. He said he knew nothing about machinery and his only assurance of getting a good plant was to keep it running without too many breakdowns for the next few months. So a clause was put into the agreement that if there were more than six forced shutdowns in the first two months, one-quarter the purchase price would be refunded. This was the amount of down payment. Hung agreed after I assured him I'd stick around for the first two months to keep the plant going. After two months, the No. 1 native operator would take over.

"The papers were signed that afternoon. I received a draft on the Victoria Bank of Colombo for $1000, as Hung had promised. This was in addition to my salary. And he promised me another bonus if I kept the plant running for the next two months.

"Next few days kept me busy charging the system and keeping an eagle eye on everything so I'd make that extra bonus of $200. But on the third day, an evaporator coil blocked and I had to shut down. We opened the coil for cleaning, but found it was clean as a whistle. So we buttoned her up and started up again. Shortly after, the coil blocked again. Again we shut down and opened up, but again the coil was clean. By then I was sweating blood, and so was Hung.

"Next morning I opened a separator on a compressor suction and looked inside with a candle. Suddenly a blue flame burst out of the inspection hole, singeing my starboard ear. I quickly slapped my hand over the hole and slammed the door back on.

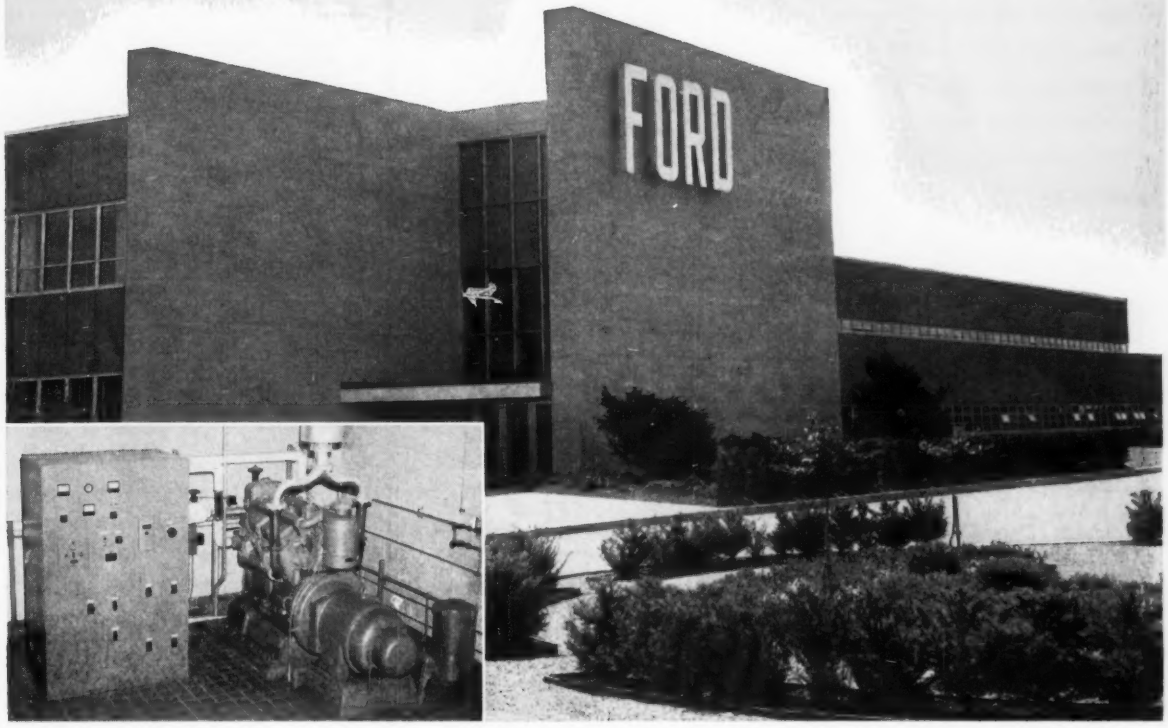
"Here was a clue—so I bled a little gas into the separator and tried the candle trick again. Sure enough, a blue flame shot out and no mistake about it. I then bubbled the gas through caustic soda. It showed only about 70% CO_2. The rest was probably butane and propane.

"Hung and I did a little detective work that evening by taking out the Parsi's No. 1 man and getting him drunk. We learned that the CO_2 bottles had been 'gotten' from the British army. They had contained bottled fuel gas. The Parsi was a chemist and had the CO_2 pumped in on top of the fuel, giving us a mixture.

"Now I knew that propane and butane are good refrigerants. But at the high CO_2 system pressures of over 1000 psi, they not only liquefied in the evaporator coils, but solidified. At first there was just enough propane and butane to help the refrigeration without blocking anything. But when enough had

At Ford Motor Co. of Canada

A CAT* ELECTRIC SET GUARDS AGAINST POWER FAILURE



In case of power failure, electric current will continue for such vital functions as lighting, teletype communication and hospital needs at Ford Motor Co. of Canada.

The Oakville, Ontario, plant has a dependable Caterpillar Electric Set for emergency protection. This power package, always on guard against power interruptions, makes a clean, compact installation. And it provides up to 150 KW of power.

There is a complete line of these Cat Electric Sets up to 350 KW. If greater capacity is needed, two or more electric sets are easily synchronized. And you can have them tailored to your exact needs. For instance, you can get them equipped with independent gasoline starting engines, air or electric starting, or automatic start-stop for standby.

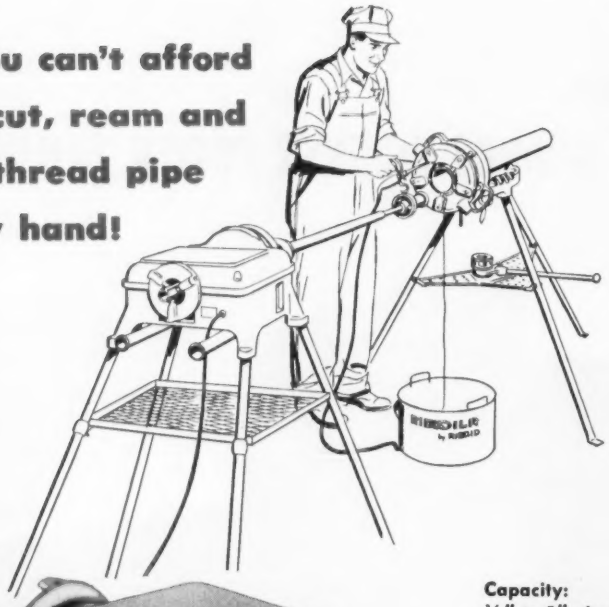
Reliability of Cat Electric Sets is more than a matter of engineering design. Quality materials combine with quality workmanship to produce the best buy. Also, with each set you have the added protection of quick, efficient service from your Caterpillar Dealer. He is ready 24 hours a day to keep your equipment in tiptop shape with Caterpillar quality parts. See him soon! He'll help you select the set that fits your needs.

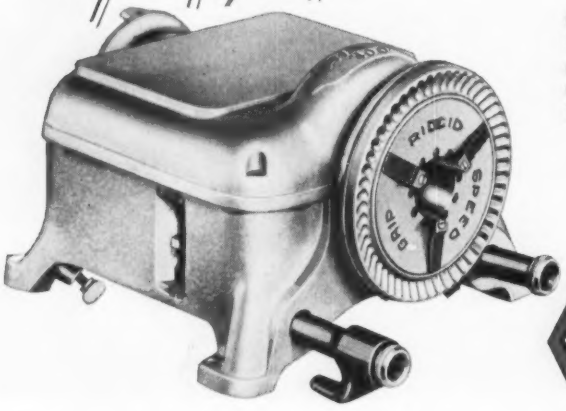
Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

You can't afford to cut, ream and thread pipe by hand!





Capacity: ⅛" to 2" pipe, conduit; to 12' with geared tools; ¼" to 2" bolts.

Every RIDGID Pipe Tool TESTED individually before shipment

RIDGID 400A

powers your hand tools . . . saves you time and work!

Your job is so much easier, faster when this stout little power drive turns pipe, conduit, rod for your hand tools.

Easy hand-action Speed Chuck holds tight forward or reverse. Full of RIDGID features that give you far the most time and work saving for your money—see it, try it at your Supply House.

The Ridge Tool Company, Elyria, Ohio, U.S.A.

RIDGID
Work-Saver Pipe Tools

MARMADUKE

Continued from page 176

accumulated from gas makeup, the frozen gas would block the line. When the evaporator was pumped down and had warmed up a bit, there was no blocking because the gas had evaporated.

"I explained to Hung—who was interested but didn't know what I was talking about—that this caused our flammable CO_2 and the disappearing stoppage in the evaporator. After that, I kept about 10% butane in the system by continuous purging and everything worked fine.

"The Parsi never did find out how I straightened out that plant with those phony CO_2 bottles. He tried to give Hung trouble when the two months were up and he didn't get the refund of his purchase price. But that crooked chemist was smart enough to know he didn't have a legal leg to stand on—and he knew we knew it.

"Hung shoved off on a slow boat to Hong Kong with Rose Sahibo and a bloated bank roll. I stowed my bonus into my money belt and signed aboard a Greek ship headed for France. After working in that icehouse all summer, I knew just the place to get thawed out—Paris. *SME*

Marmy's Mailbox

'Tis here you exchange blasts with the old boy

A BONER? . . .

For ten years I've been trying to catch Marmy pulling a boner. In "Beer can science," May '57, he blows the fuel-oil vent with oxygen. Anyone else would have been blown to Jupiter. But now I know the old boy is human—he can pull a boner like the rest of us.

I D STILWELL, *Topeka, Kansas*

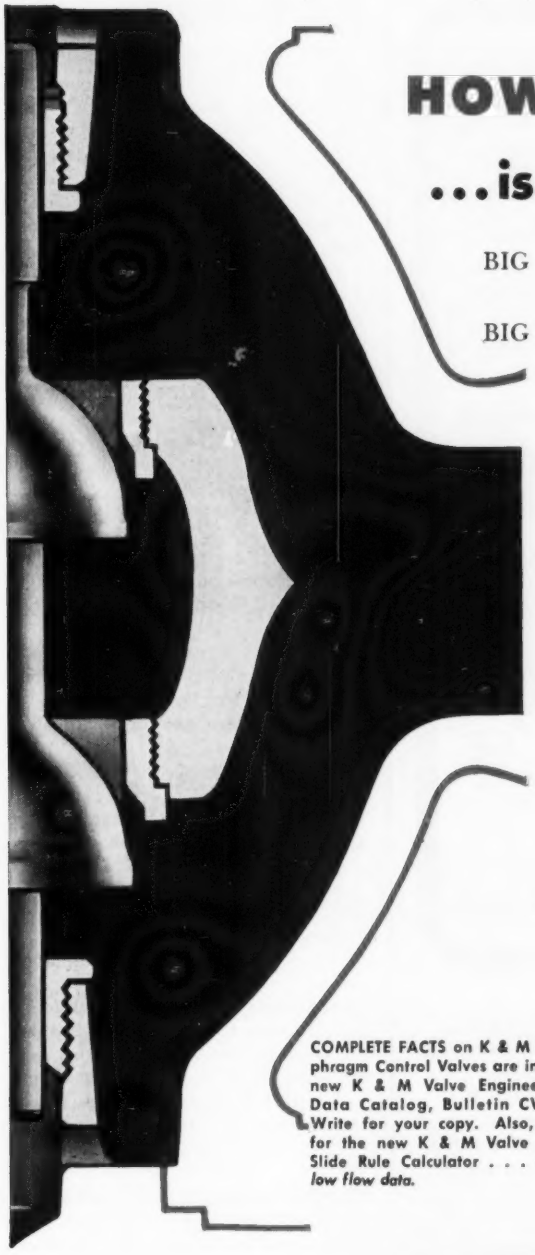
Marmy was lucky he didn't at least lose that gray bowler—wow!

R E VALENTINE, *New York City*

Accept my condolences upon the death of Marmaduke Surfaceblow, Esq. All of us know you cannot—under any circumstances—let oxygen come in contact with oil, grease or pipe-joint compound. It's dynamite!

F L GILLMOR, *Albany, N. Y.*

Linde Air Products says "Serious accident may result if oxygen is used to



HOW BIG

...is a K & M six-inch valve?

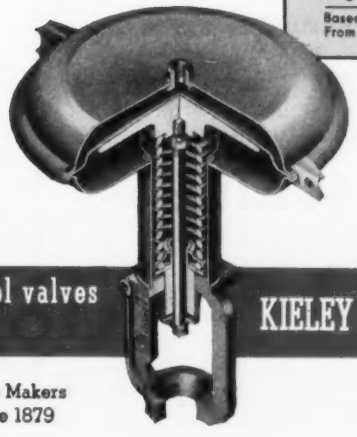
BIG enough to pass 500 gpm of cold water through the valve body at a constant drop of one pound pressure. BIG enough to provide the largest flow coefficient available in a standard six-inch diaphragm control valve. Body flow passages of all K & M valves, for example, actually average 140% of cross-sectional pipe area. There's more space for fluid to flow . . . smoothly, freely and without turbulence. Frequently a smaller nominal size K & M Valve provides sufficient capacity to satisfy requirements that formerly called for a larger, more expensive valve. Inner valve open areas, on the other hand, average only 80% of cross-sectional pipe area. Therefore, flow restrictions occur principally across the inner valve . . . where the restriction is controllable throughout the entire range of valve stem travel. This K & M design often permits lower initial costs . . . always contributes to more precise flow regulation through the K & M Inner Valve.

COMPLETE FACTS on K & M Diaphragm Control Valves are in the new K & M Valve Engineering Data Catalog, Bulletin CV53. Write for your copy. Also, ask for the new K & M Valve Size Slide Rule Calculator . . . with *low flow data.*

C_V COMPARISON TABLE

Valve Size	K & M	Valve B	Valve C
¾"	10.9	8.4	8
1"	17.3	14.9	12
1½"	39.1	33.2	28
2"	61	57	48
2½"	97.7	71.0	72
3"	150	116	100
4"	219	197	165
6"	500	364	360

Based on the maximum C_V at rated travel through the valve body. From manufacturers most recent slide rules or tables.



diaphragm control valves

K&M

Valve Makers Since 1879

KIELEY & MUELLER, INC.

64 Genung Street
Middletown, New York

WHAT TO BUY! WHAT TO BUY! PETE PACKING TO THE RESCUE

THE BIG 7 BOOK MAKES THE PURCHASING AGENT'S JOB A CINCH

It used to be that a buyer of packing had to be a packing *expert* to select the right type for each and every need. Now, with the R/M Big 7 book, the work is cut to the bone. With only 7 types to choose from, it's almost impossible to go wrong. Most plants find that only 3 or 4 types can handle all their problems.

There are many other big dividend, too. Minimum initial investment, less inventory, faster delivery.

Have you seen the R/M Big 7 book? Your R/M distributor has a copy. Give him a call and ask him to tell you the whole story about how this simplified line of packings can make life easier for you.

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M packings for maintenance purposes are sold only through authorized R/M distributors

R/M BIG 7 PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

MARMY'S MAILBOX

Continued from page 178

blow out lines. Violent explosions can result from even momentary contact with hydrocarbons."

H STONE, *Benton, Ark.*

I've been following Marmy too long to believe he brought oxygen in contact with a hydrocarbon.

H M ANDREWS, *Lakewood, Calif.*

Marmy would never use oxygen to blow a fuel line. I've been following him too long to believe that.

J H BOYER, *Frederick, Md.*

If Marmy wants to expand by blowing fuel lines with oxygen tell him to come to North Dakota—we have room.

L A WOODWARD, *Dickinson, N. D.*

Only Marmy could get by with blowing hydrocarbons with oxygen—or did he?

R R CRABTREE, *Pine Bluff, Ark.*

If Marmy doesn't care to live, he should think of us who go home to our kids and to mow our lawns at the end of the day. Oxygen and hydrocarbons—wow!

I ROWE, *Murray Hill, N. J.*

I'm sure Marmy used compressed air and not oxygen. Please ask him.

F C SAACK, *New York, N. Y.*

Old Surfaceblow is tops, but keep him, oxygen and hydrocarbons apart.

J BALDWIN, *Detroit, Mich.*

At coffeetime once each month I translate Marmy's latest story into Spanish for my department. If I tried that oxygen stunt I'd be blown up. But Marmy can do that so long as he keeps sounding off—for many years, I hope.

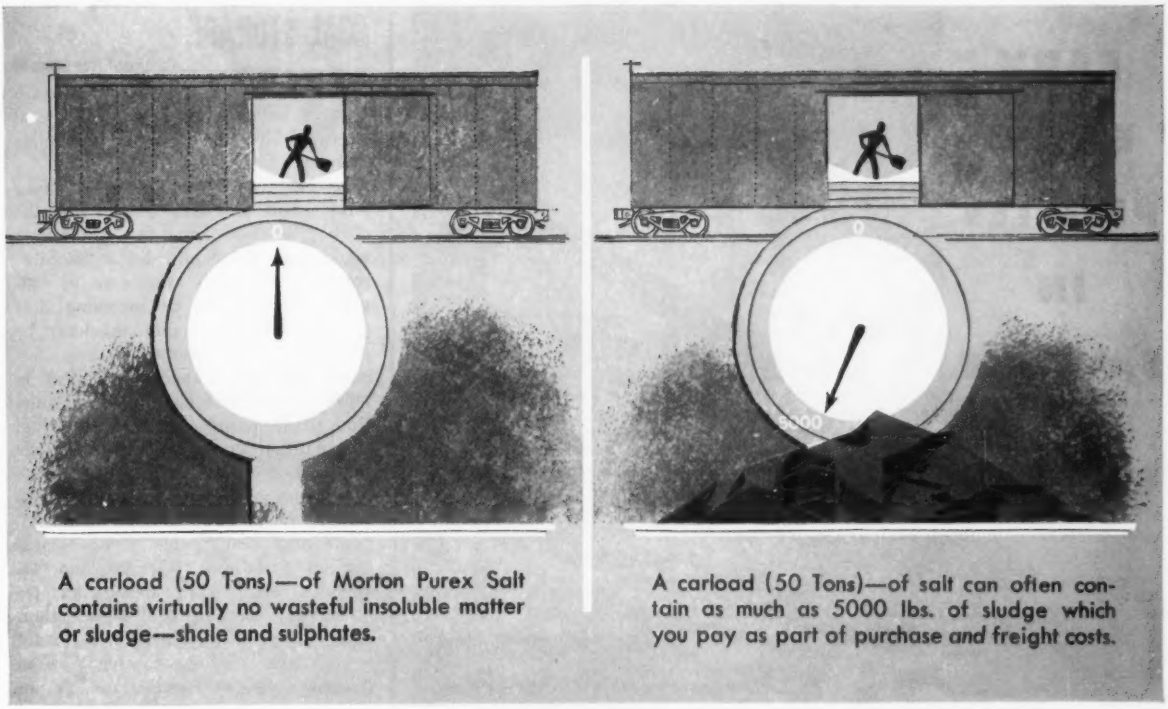
R GALVIS, *Cali, Columbia*

I've seen one ship blown up because a yard mechanic blew an oil line with oxygen—so I grabbed the phone as soon as I read that beer can story.

A V GRUBER, *Hoboken, N. J.*

MARMY'S NOTE: Bilgewater, I used CO_2. You editors fouled me up.

EDITOR'S NOTE: Yes, Marmy is right. He said CO_2, but somehow between us and the printer this became just plain O and that turned into oxygen. Every mechanic, weldor and engineer who has handled oxygen knows you can't use it for hydrocarbons and live to tell the tale. You Marmy fans have been calling and writing us from all corners of the world. Please leave Marmy out of this—I'll take the rap. The old consultant is too smart to pull a stunt that dumb.—STEVE ELONKA

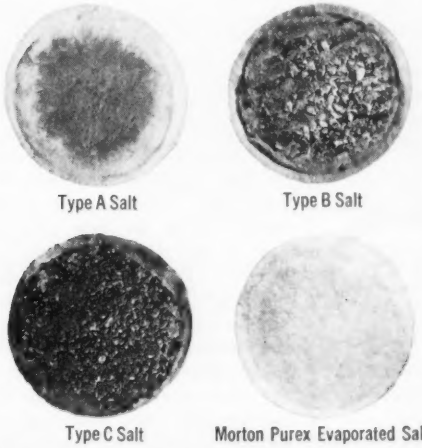


A carload (50 Tons)—of Morton Purex Salt contains virtually no wasteful insoluble matter or sludge—shale and sulphates.

A carload (50 Tons)—of salt can often contain as much as 5000 lbs. of sludge which you pay as part of purchase *and* freight costs.

Stop paying for wasteful sludge —switch to Purex Salt

These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.



Type A Salt

Type B Salt

Type C Salt

Morton Purex Evaporated Salt

Tests for insolubles taken from random samples show you that Morton Purex is the only one that contains no wasteful sludge or insolubles.

For more information about Morton Purex Salt, and for free, expert help on any water-softening problem, write:

When you buy Morton Purex Salt, you get high purity evaporated salt that is made in a controlled-particle size to prevent packing and channeling. With Purex, none of your purchase price or freight bill goes toward paying for useless, troublesome insoluble matter.

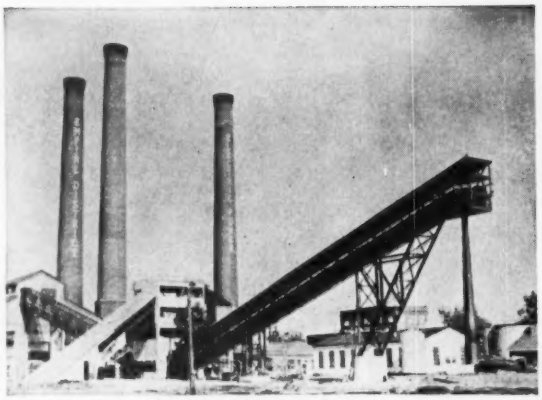
With Morton Purex, no time or labor is wasted in cleaning out insoluble matter from your brine making system to keep it functioning at peak capacity. For Purex is 100% soluble. Morton Purex will leave no accumulation of material in either brine or water softener tanks. It can be used in wet-storage systems, and in the Morton Model-E Brinemaker.

MORTON SALT COMPANY

INDUSTRIAL DIVISION

Dept. P-10 120 So. LaSalle Street, Chicago 3, Illinois

EARN EXTRA PROFITS IN SAVINGS



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.

McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

—With Cost-Cutting

COAL-HANDLING SYSTEMS

Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

McNALLY PITTSBURG

"The Men Who Know Coal From The Ground-Up"

McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ **Title**_____

Company_____

City and State_____

COAL STORAGE

Continued from page 88

ward and coal is more readily available at better prices, with plenty of cars and locomotives to assure regular delivery.

It isn't always easy to convince power-plant operating people that the coal pile must serve as a working warehouse. It should be a "mobile" reservoir that will take care of outgoing consumption or incoming flow of coal. The coal pile shouldn't be reserved for emergencies.

It's admitted that it takes work to move coal to or from the storage pile. But all it actually costs is the fuel consumption and maintenance of the handling equipment. The labor is already there and, if overtime isn't involved, no extra costs are incurred. Some published figures on coal-stocking costs indicate 4.1c per ton for stocking and 7.9c for stocking and reclaiming, including bulldozer labor. Some estimates for smaller plants not having bulk-handling equipment used by larger plants, charge up to 25c per ton for storage handling costs. Considering that coal-producing costs will continue to rise, and that transportation costs are likely to follow suit, a comparison of storing costs with destination price fluctuations will prove the economics of a mobile stockpile.

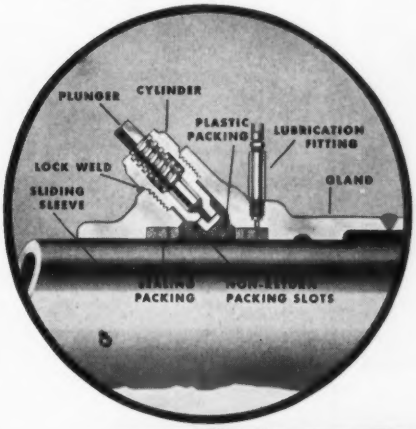
Storage pile control of this type could greatly assist coal producers and carriers. The coal business is seldom steady—at times approaches the "feast or famine" category. Prices follow in almost direct ratio to demand. Storage procurement serves as a coal-production stabilizer at price advantages to the stockpiler. At the same time, since transportation facilities follow the waves of supply and demand, storage procurement could be regulated to ease transportation shortages or, conversely, keep the facilities busy when they tend to become idle.

It may be argued that changing the coal in a storage pile produces the maximum rate of deterioration or weathering. Greatest heat content loss occurs within the first year that the coal is laid down. A fairly accurate estimate shows the loss to be 1.2% the first year, 0.9% the second year, and so on. A 1% loss of the 13,300-Btu content of our average purchased coal, costing about 26c per million Btu as received, would mean about 7c per ton per year. This loss continues whether the coal pile is altered or not. It's negligible compared to savings made possible by prudent stockpiling.

Fiscal values of the coal pile may be benefited by timely alterations in its size and financial inventory. State

new savings
for expansion joint users

Cross-section of Gun-Pakt feature. To add packing, just add a plug and turn the plunger. Note non-return packing slots at bottom of cylinder.



The Yarway Type W Gun-Pakt Expansion Joint has an improved one-piece design of body and gland and improved method of packing that provide new maintenance economies and greater operating efficiency.

Bolted joint between body and gland is eliminated; the steel body includes gland and guide. Shorter face-to-face dimensions are possible. Improved angle of packing guns makes them more accessible and *permits injection of the special plastic packing directly into packing space.*

The famous Yarway *Gun-Pakt* feature permits *addition of packing under full steam pressure. No need for costly shutdowns to repack.*

Sizes 1½" to 30", pressures 150, 300, 400 psi. Single or double types, flanged or welding ends.

For full description, write for new Yarway Bulletin EJ-1916.

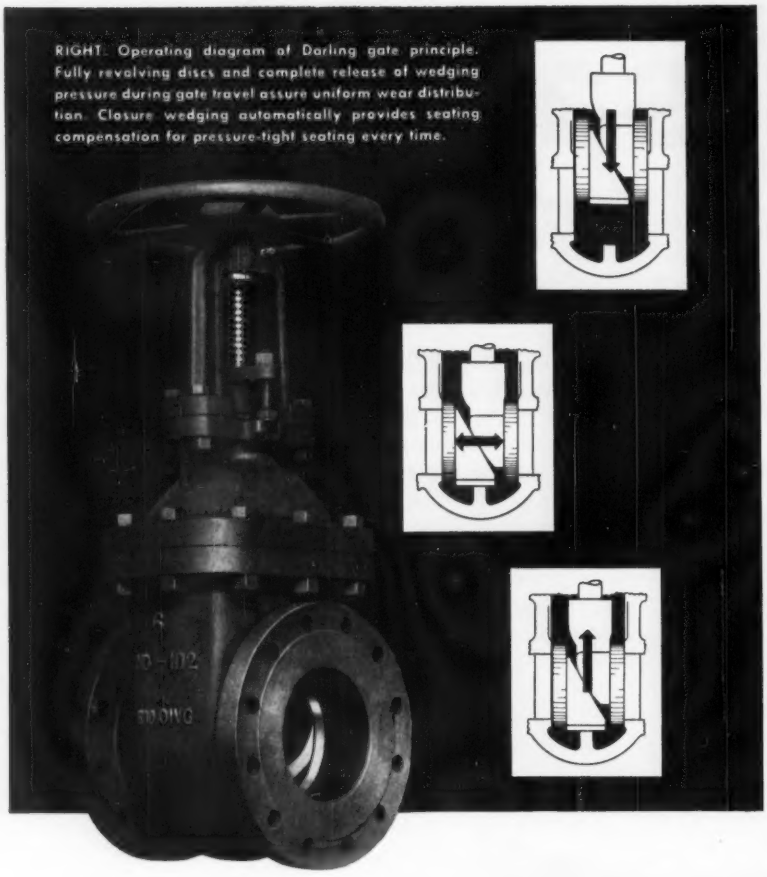
20" Yarway Type W Gun-Pakt Joint with base, single type, welding ends, 8 guns.

YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY GUN-PAKT

...a good way to specify expansion joints

RIGHT. Operating diagram of Darling gate principle. Fully revolving discs and complete release of wedging pressure during gate travel assure uniform wear distribution. Closure wedging automatically provides seating compensation for pressure-tight seating every time.



How Darling gate valves can help

MAINTAIN PROCESS SCHEDULES

THE unique Darling gate valve principle, diagrammed above, provides today's best assurance of prolonged good behavior and avoidance of leaks and process interruptions! It's a natural where the most reliable operation is vital month in, month out.

You'll find this feature in Darling's economical hard-rubber-lined iron body valves for corrosion services up to 150 pounds. Same goes for other Darling gate valves in sizes, types and metals of various alloys for all kinds of normal and unusual services. Write for Catalog No. 57.

ENGINEERING SERVICE: Darling offers unusual facilities for the development and manufacture of special valves for out-of-the-ordinary requirements. This special service is available to you at all times, without obligation.

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by
Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING
DARLING
VALVES

COAL STORAGE

Continued from page 182

or local property taxes may be based on tonnages or investment values at certain times of the year and physical inventories may assume greater importance on fixed dates. There are accounting as well as fiscal considerations that may favor mobile rather than fixed storage quantities. It can be predicted with impunity that a shift from "sleeping giant" to mobile coal storage piles would result in specific advantages to all concerned with this basic fuel.

My biggest boner

Who in hell ever checks blowdown valves with water in the glass? I didn't, but I do *now*. As an engineer on No. 3 shift, I have charge of two Wickes and two B&W watertube boilers of 20,000 and 25,000-lb-steam-per-hr capacity.

Verbal orders were given to light off No. 1 Wickes. We were also told that the second shift had drained the boiler down to operating level. A quick glance at the water glass gave proof to the statement. So the operators checked the topside of one boiler and then lit off furnace.

Since our mechanics are notorious for not tightening hand-hole plate nuts, I went for a wrench to do a little checking of my own. The wrench hangs over one of the waterwall blowdown valves. As I picked it up, I glanced at the inside blowdown valve. It was open. Reaching down to close it, I noticed both blowdown valves were open.

I quickly closed the burner valve. Inspecting further, I found both the main and opposite waterwall blowdown valves open. Returning to the boiler front, a slight tug on the gage-glass pullchains verified the old saying that you can believe only half of what you see. Only water in that boiler was trapped in the gage glass.

I called the boss. My report disturbed his night's sleep, causing his ulcers to kick up a storm.

Following day we learned that the operator assigned to drain down the boiler had been called away and forgot to go back to close the valves. Boiler inspector was called—for a fee, of course. He found four tubes bent and leaking. So he recommended all tubes be re-expanded. Cost was $1500.

G H Byers, *Ann Arbor, Mich.*

Consider

the advantages of one responsibility for your next power station!

Tom Fort, Vice President,
Apparatus Division,
Westinghouse Electric Corporation

Westinghouse apparatus available for power plant applications

Air Conditioning Equipment
Arc Welders
Atomic Reactor and Auxiliaries
Automatic Dispatching Equipment
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Control Boards
Control Centers
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Evaporators
Fans
Feedwater Heaters
Gear Speed Increasers
Gear Speed Reducers
Generators, Main and Auxiliary
Generator Voltage Regulator
Group Phase Bus
Instruments
Instrument Transformers
Isolated Phase Bus
Lighting Equipment
Lightning Arresters
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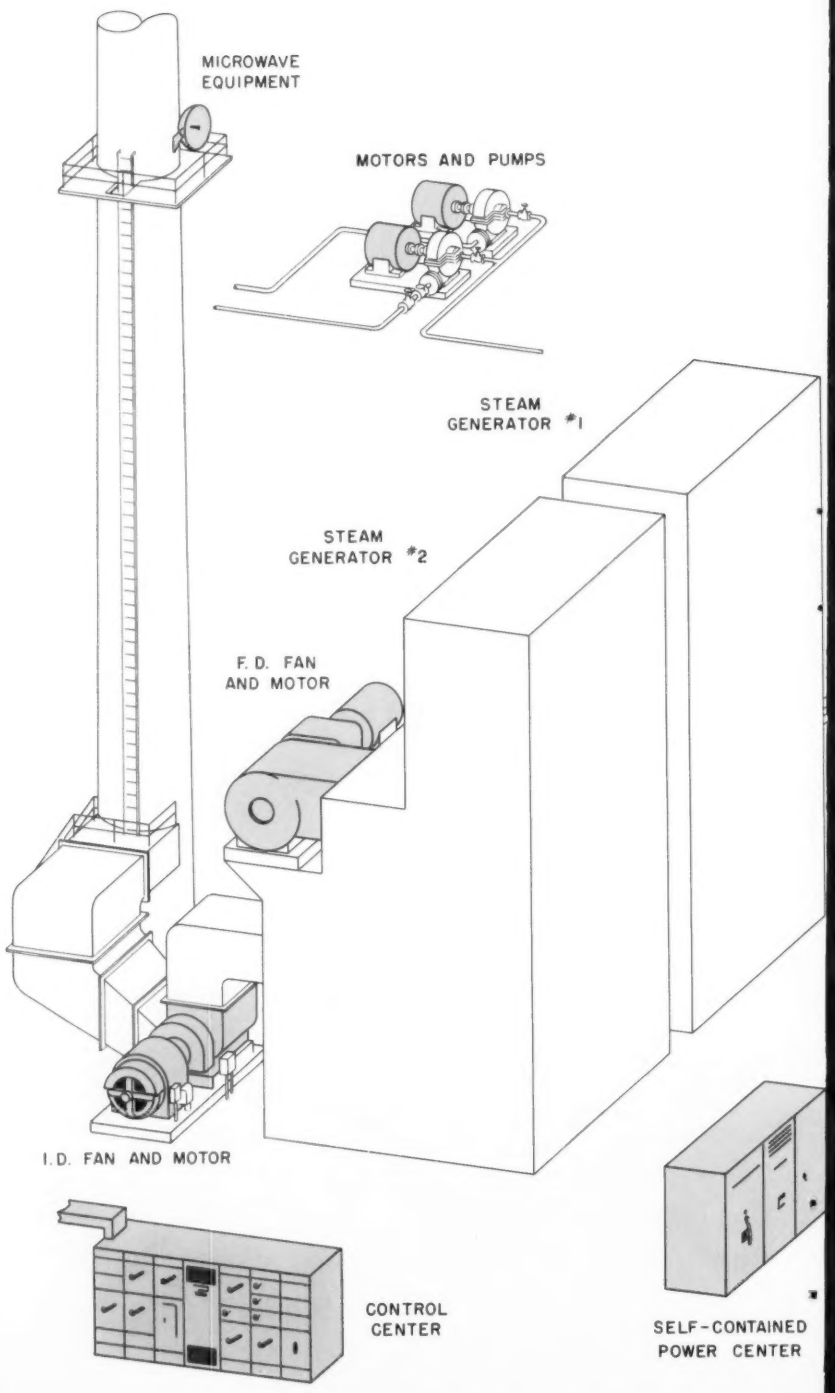
Steam Condensers
Steam Jet Air Ejectors
Supervisory Control
Surge Protection Equipment
Switchboards
Switchgear
Switchyard Structure
System Grounding Equipment
Telemetering Equipment
Transformers, Main and Auxiliary
Turbines, Steam or Gas, Main and Auxiliary
Unit Heaters
Ventilating Fans
Water Coolers

*Trade-Mark



Westinghouse can supply all this powerhouse equipment

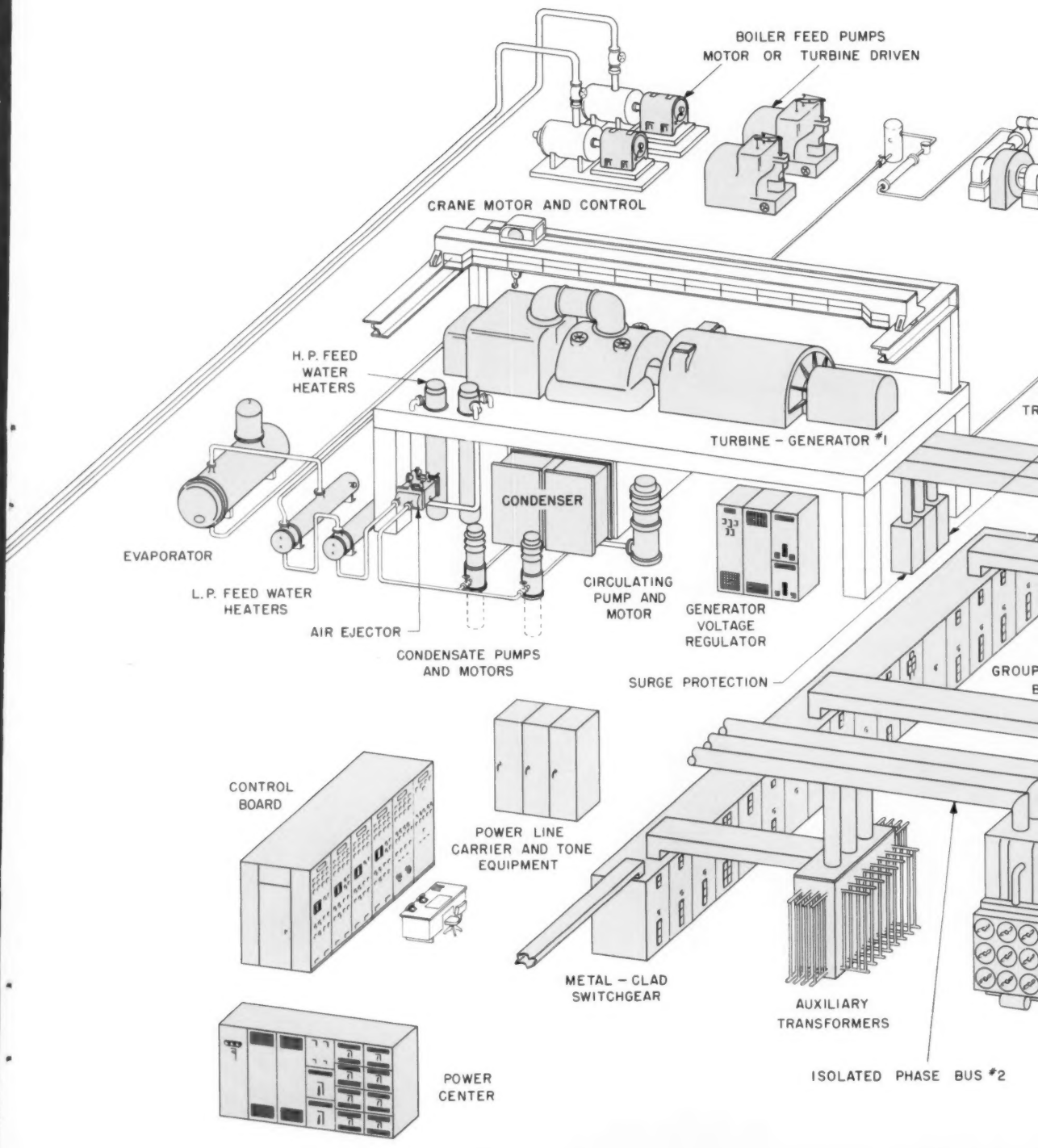
Think of the time, trouble and processing you can save with:

ONE ORDER
ONE CONTACT
ONE RESPONSIBILITY

YOU CAN BE SURE...IF IT'S

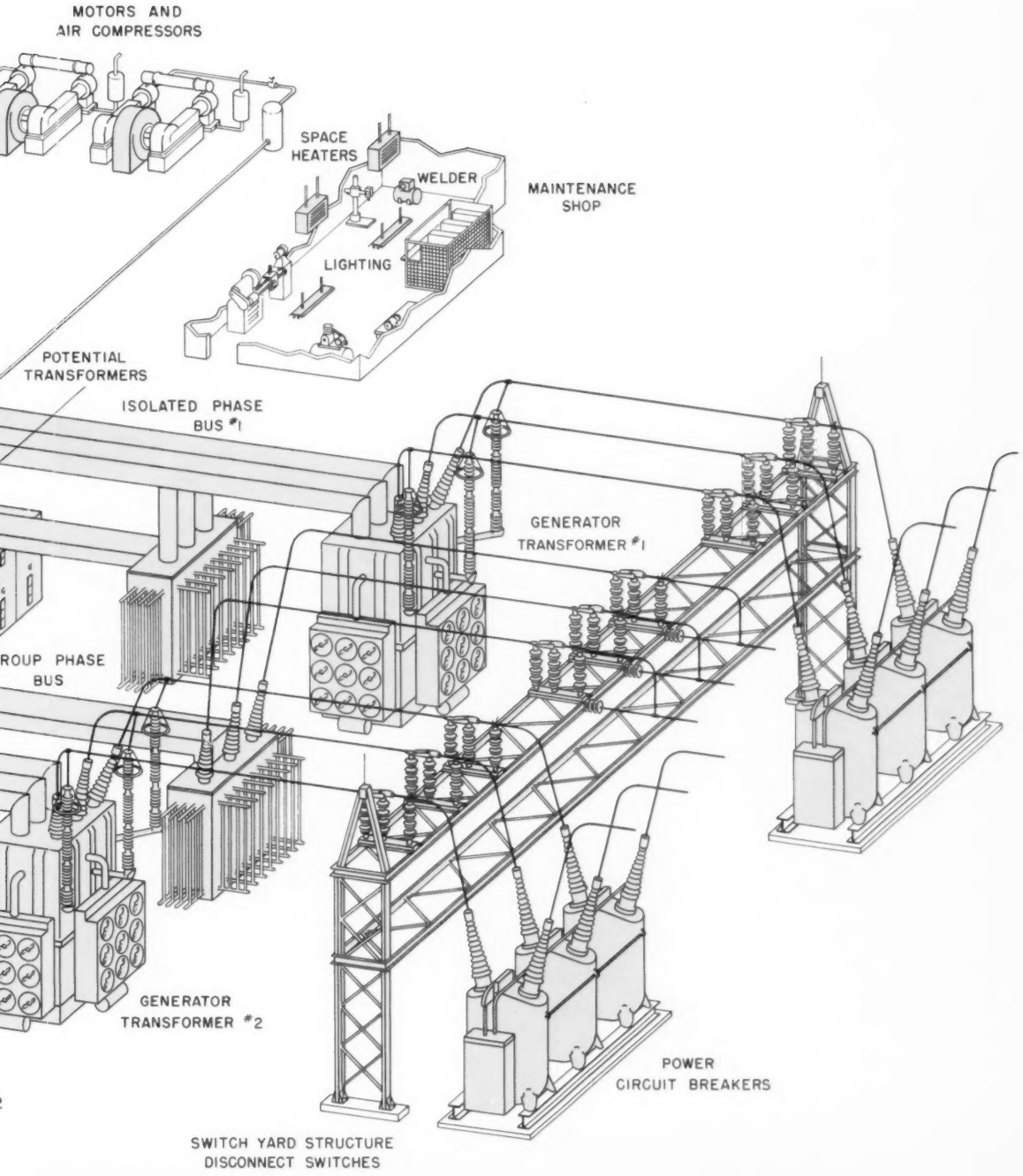
Westinghouse

ONE ORDER, ONE CON



A print of this artwork, suitable for framing, is available free of charge, write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

NTACT, ONE RESPONSIBILITY



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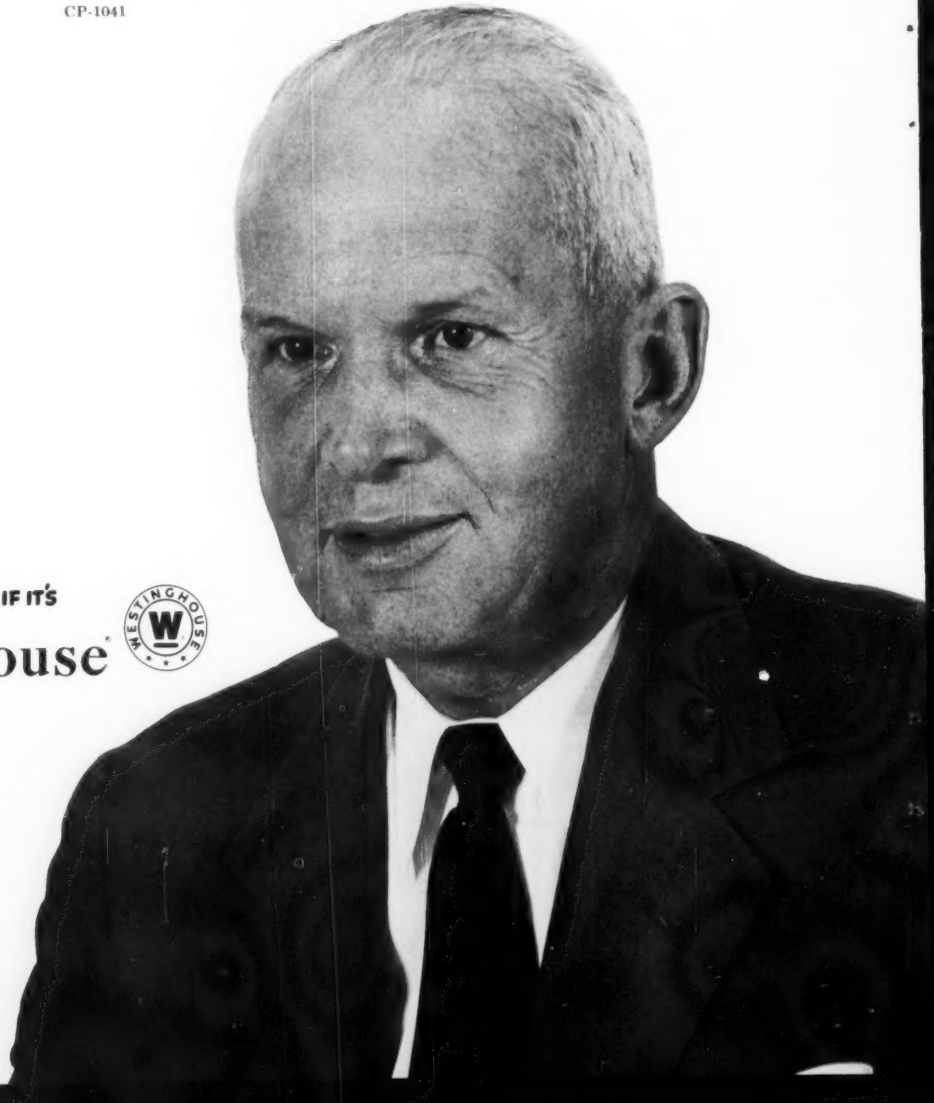
IT'S ALL ONE

The broad scope of Westinghouse stands ready to cooperate with you and your consultants. Your orders to Westinghouse not only take advantage of all this research, development and engineering, they support it, too. One man, your local Westinghouse representative, is your key man to it all. CP-1041

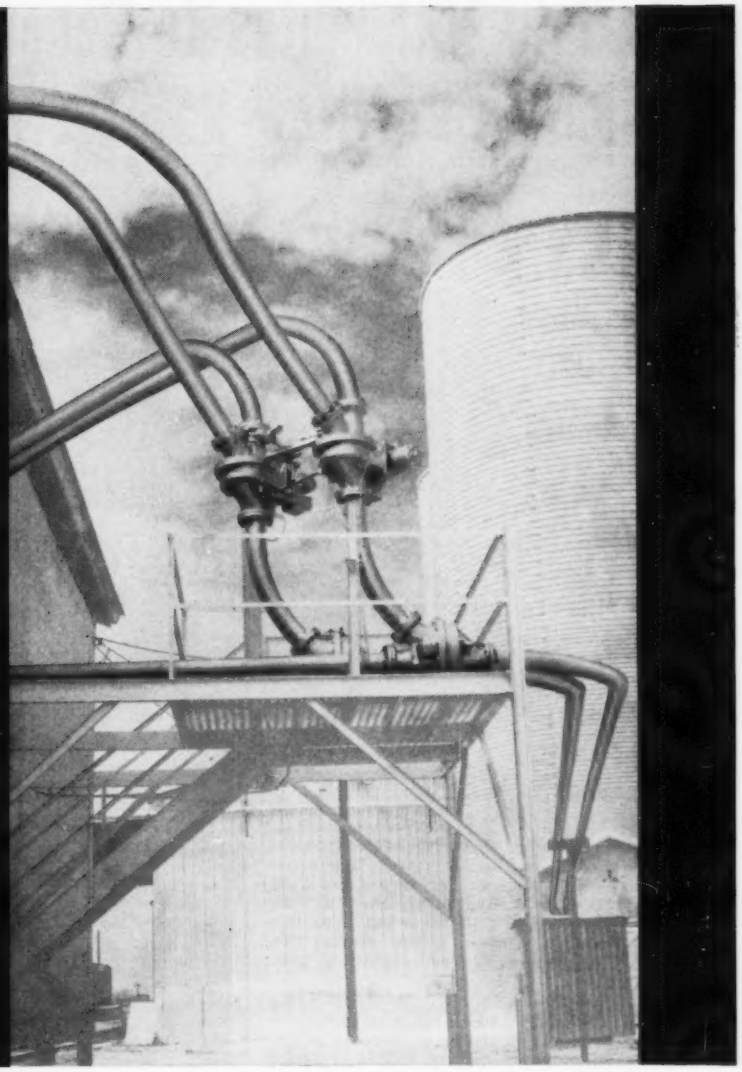


YOU CAN BE SURE...IF IT'S

Westinghouse

Minerals & Chemicals Corporation of America found...

It pays to specify Alcoa Aluminum Pipe to lick corrosion, prevent product contamination



When resistance to corrosion and freedom from product contamination are important, aluminum pipe is the low cost answer. Here's a case in point:

The McIntyre, Georgia, plant of Minerals & Chemicals Corporation processes Kaolin clays. Pipe originally used in corrosive stages of their process failed in as little as six months. In 1954, they specified ALCOA® Aluminum Pipe to replace it.

The natural corrosion resistance of aluminum has kept it in constant service without the heavy maintenance and replacement expense experienced before. Costly production shutdowns for pipe replacement have been eliminated. Moreover, the aluminum pipe has insured delivery of a pure, iron-free product . . . while the pipe's smooth, clean surface keeps friction loss at a minimum for low pumping costs.

Minerals & Chemicals' engineers sum up their experience this way: "Our original ALCOA Aluminum Pipe proved that it pays to specify aluminum when corrosion is a threat. Now we're using more aluminum pipe as well as aluminum siding and roofing for many of our buildings and conveying systems."

If *you* are troubled by corrosion or product contamination, it will pay you to investigate aluminum today. The convenient coupon will get complete information to you immediately.

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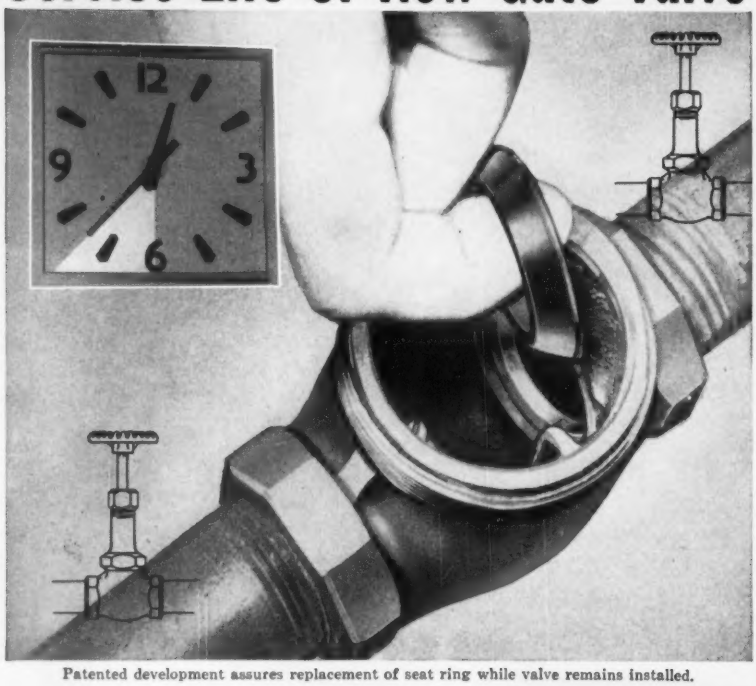

Patented development assures replacement of seat ring while valve remains installed.

Without removing the valve body from the line, you replace the nickel-alloy seat rings in Fairbanks new patented Renewable Seat Ring Gate Valves. In 7 to 10 minutes, from the time the line is shut down until it is put back into operation, you have given a new service life, a new life of dependable tight closure to your valve.

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Field tested for over two years, under all conditions from steam to corrosive liquids, the revolutionary new Fairbanks Renewable Seat Ring Bronze Gate Valve has proven completely satisfactory — absolutely dependable.

Made with either rising stem or non-rising stem construction in ½",¾",1", 1¼",1½" and 2" sizes, the Fairbanks Renewable Seat Ring Bronze Gate Valves are recommended for severe service conditions on 200 lb. steam pressure at 550 degrees F., 400 lb. water, oil or gas pressure — non-shock — lines requiring full flow and subject to frequent operation. Nickel alloy seat rings and wedge make the valves particularly tough and corrosion resistant.

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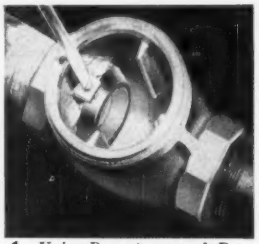
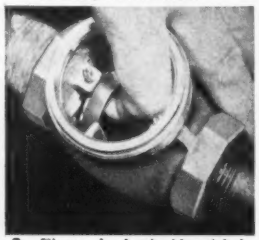


1. Union Bonnet removed. Retaining screw loosened with ordinary screwdriver.



2. Finger hooks inside nickel alloy seat ring. Seat ring lifts out of valve body.

3. New seat ring is inserted. Retaining screw tightened. Bonnet replaced.

CONDENSERS

Continued from page 85

ing may dry out if condenser waterboxes are drained. Then it may be advisable to refill condenser with clean fresh water after the tubes have been cleaned.

Condensate contamination, whether from condenser tube failure or packing or tube roll leakage, is undesirable. It may also be dangerous, as boiler water conditioning is disrupted and scale-forming or carryover-promoting water concentrations may develop.

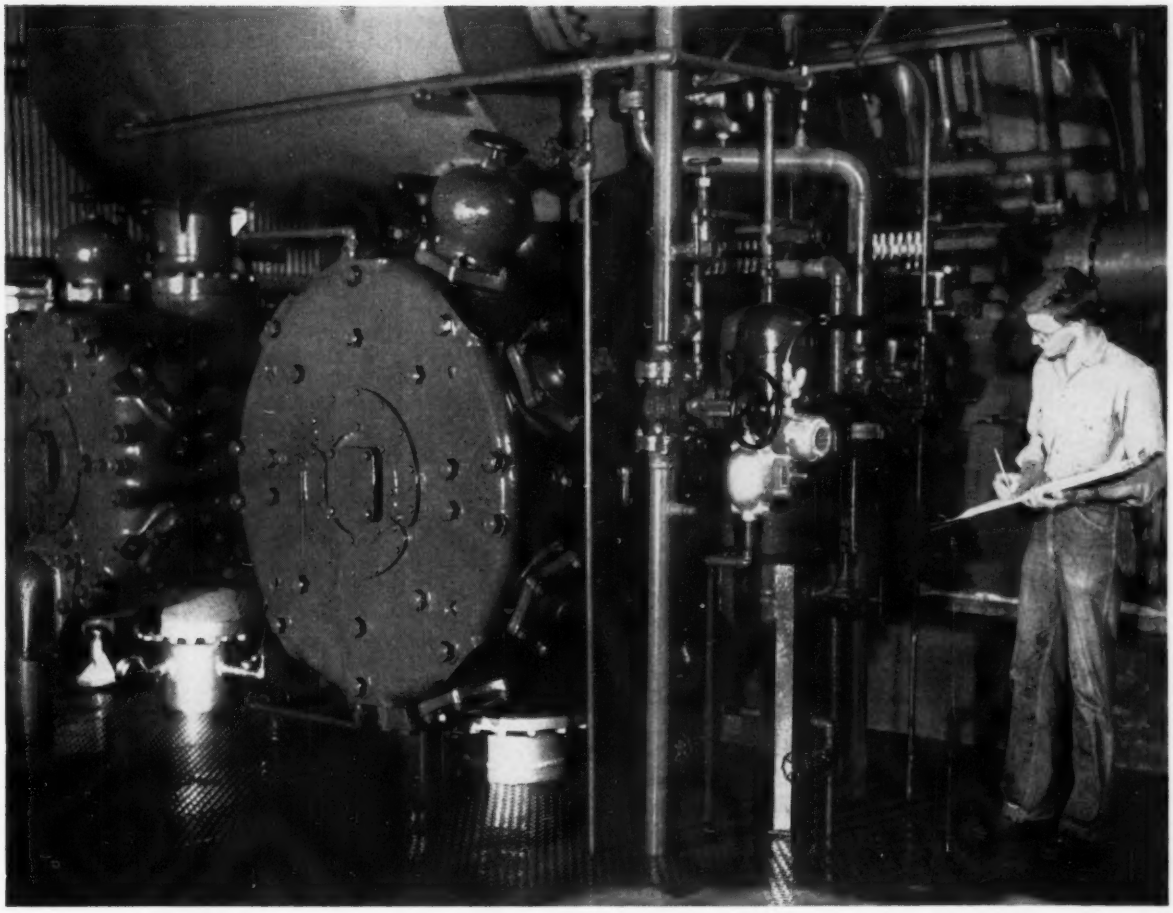
A heavy leak, as from one or more broken tubes, usually is indicated by a rise in level of condensate storage or deaerator storage tanks. If sea water is used for condensing, chloride and hardness content of boiler water rises rapidly with leakage since boiler water phosphate levels are not sufficient to cope for long with excessive hardness contamination.

Smaller leaks are harder to identify but there is more time before dangerous conditions develop. A change in conductivity is the most sensitive test for condenser leaks. You can detach an increase in conductivity by recording conductivity of a sample taken from the condensate line. Daily or more frequent checks with a portable conductivity unit give the same answer but with a time delay from time leakage starts until time of the test. Equipping the recorder with an alarm set at a predetermined safe conductivity level provides immediate notice.

Other factors may also change condensate conductivity such as temperature, boiler water, carryover or carbon dioxide, ammonia, and other dissolved gases that enter the condensate circuit. Recording conductivity of feedwater leaving the deaerator and of condensed steam from the boiler assist in analyzing the reason for increased conductivity in condensate.

Finding the leak. Once you determine that contamination is caused by condenser leakage, you still have to find and correct the source. Here's how to do it: Shut the unit down, drain the waterboxes and fill the steam side of the condenser with water. Fill above the level of the upper tubes. Take care not to place an excessive weight on the turbine while doing this. Inspecting the tube sheets usually reveals which tubes are leaking. Small leaks, as from pin holes or packing or roll leaks, are difficult to find, particularly if the tube sheets are wet.

Fluorescein dye may be helpful. Add the dye in solution to the water as the condenser is filled. Two to four parts per million usually gives a good in-



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CONDENSERS

Continued from page 192

dication. The dye may be discernible with ordinary incandescent light, but an ultra-violet light plainly shows any trace of leakage.

For a tube defect, such as a hole or crack, there is usually nothing to do but plug the two ends of the tube, using turned tapering plugs of soft pine or hemlock. The wood swells when wet, and makes a semi-permanent repair. Another repair method is to drive tapered copper or brass plugs into the tube ends. The defective tube is later removed, at a convenient time.

If leakage is at a tube roll, rerolling may be the answer. If packing is leaking, tighten or replace it.

Tube sheets are usually made of Muntz metal, although steel plate has been used. In a few cases steel sheets corroded and the tube joints leaked. This apparently resulted from tubes being very lightly rolled, allowing a space between tube and sheet where water could enter and set up an active electrolytic cell.

Tube end, tube sheet and waterbox corrosion can be minimized by cathodic protection or by painting surfaces if coverage is complete. But otherwise the few uncovered areas corrode faster. With some combinations of metals, waterboxes may be better left unpainted.

Surface condenser shells were formerly made entirely of cast iron, but later models use steel plate partly welded in the shop and erected and final-welded in the field. Large units can thus be more readily shipped, and considerable weight is saved. Erected cost may also be less.

The shell must enclose the tube bundle and support tube sheets and support plates. Waterboxes are bolted on the ends and a connection made to the turbine exhaust. Many shapes, sizes and arrangements are used and the welded fabrication avoids the need for carrying a large stock of patterns.

Reinforcing stays inside the shell resist the atmospheric pressure that is trying to collapse the shell, hotwell and exhaust neck.

Expansion joints. Provision must be made to care for expansion of turbine, exhaust neck and condenser. One or more expansion joints in the exhaust neck may be used, or a solid connection to the turbine may be made. In this case condenser is mounted on springs which carry most of its weight, and let it move up, down or sideways as necessary. An alternate arrangement mounts the turbine-generator on

(*Continued on page* 196)

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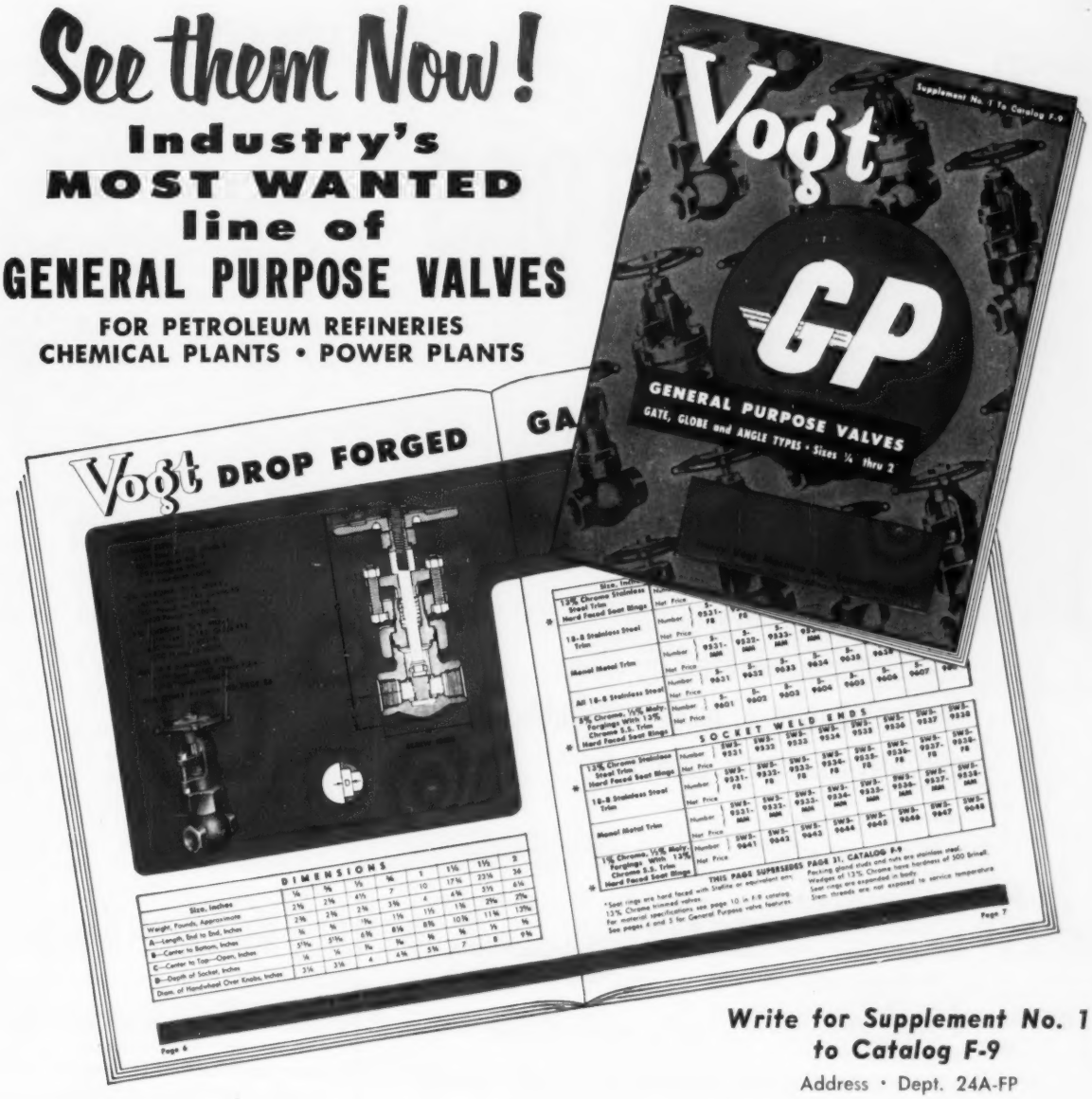

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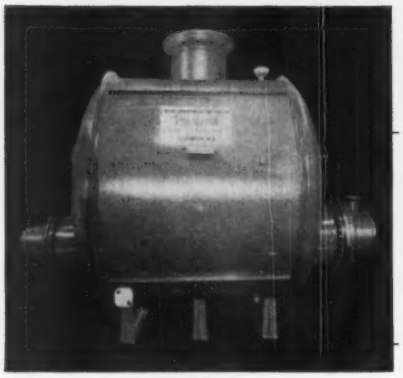

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CONDENSERS

Continued from page 194

top of the condenser, with flexible steam, water and electrical connections to the turbine-generator.

Flexible joints may be made of corrugated copper or heavy rubber. Another system uses a slip joint with a rubber seal strip that is kept flooded with water. Any type may give trouble, usually air leakage. The copper or rubber may crack or leak around the bolts. The water-sealed type becomes dirty and corroded, and seal rubber may hang up, allowing water to leak out of seal trough.

Whenever you have excessive air leakage, look at the expansion joints. If the condenser can be filled to a level above the expansion joint, you can test for leakage. But this is not always reliable, as deflection of the joint material under pressure may readily seal up a leak that is serious when condenser is under high vacuum.

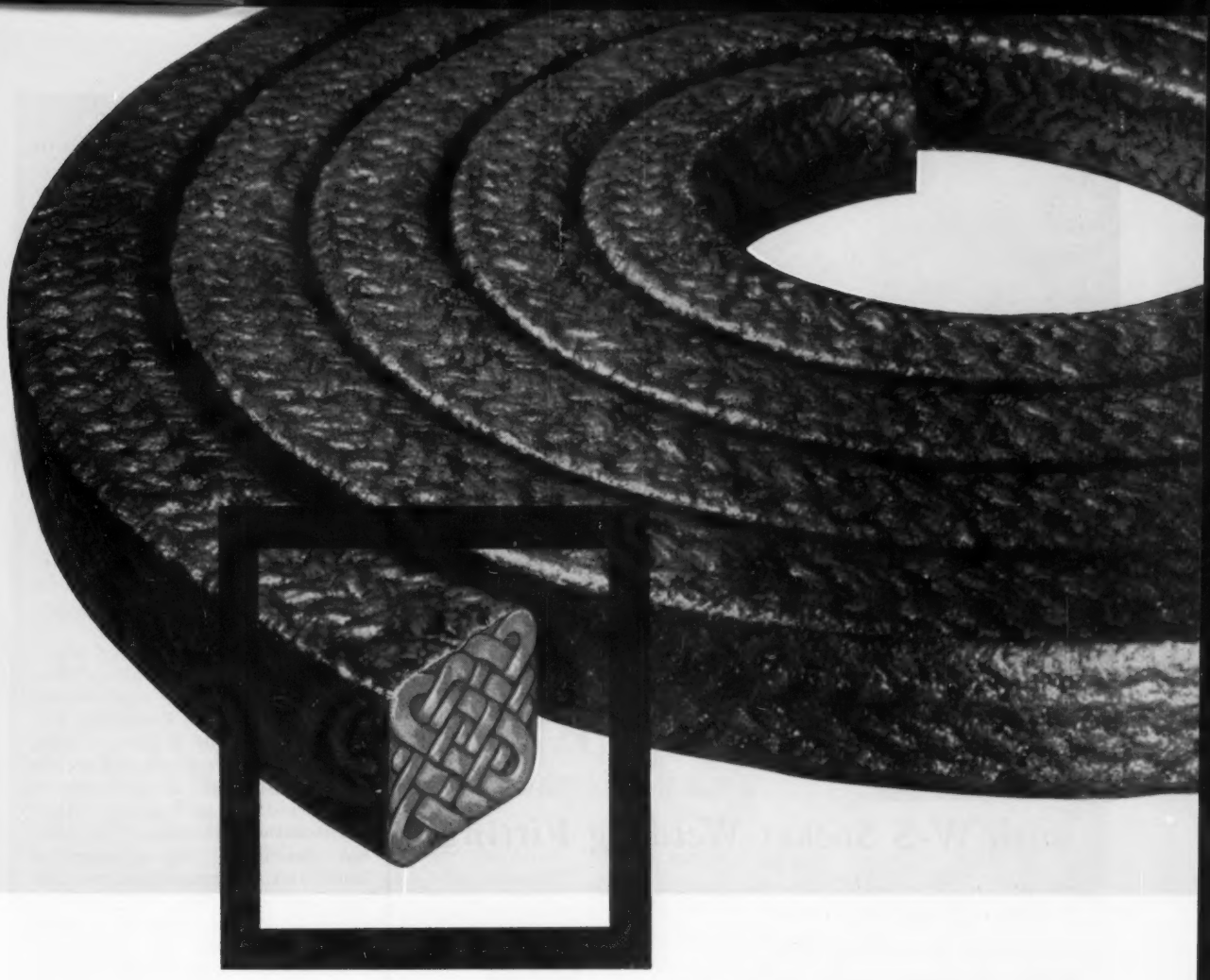
Condenser supports. When using expansion joints that permit solid supports for the condenser, you need not worry about overloading the turbine exhaust shell when making a leakage test. But this is not true for a solid connection, spring-mounted condenser. The turbine exhaust is designed for a certain maximum downward pull or upward thrust. Condenser must be set and thereafter handled so there is no excessive strain on the turbine.

Normal operating condenser weight, plus exhaust neck, tubes and waterboxes, are partially supported by specially-designed springs at each corner or along the sides of the condenser shell. Force exerted by the springs must not exert any substantial upward thrust when water is emptied from hotwell, waterboxes and tubes. Support springs are, therefore, set to carry somewhere near the empty weight of the condenser and exhaust neck.

With this spring setting, weight of water in waterboxes and tubes, plus a considerably greater amount in the steam space if it is also filled, will put too much weight on the turbine exhaust. Put jacks or blocks under the condenser before filling the steam space so condenser cannot move downward. Then the blocks will carry the increased load, rather than the turbine.

With condenser solidly blocked, make sure that unit is not started and that temperature does not rise from other causes. Condenser and exhaust neck expansion can cause a large upward thrust on the turbine. This could be even more harmful than too heavy a downward load. Put a "Hold" tag on the turbine throttle for the entire time

(*Continued on page* 198)



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Note the construction at the cutaway end of the above illustration. For further details we invite your inquiry.

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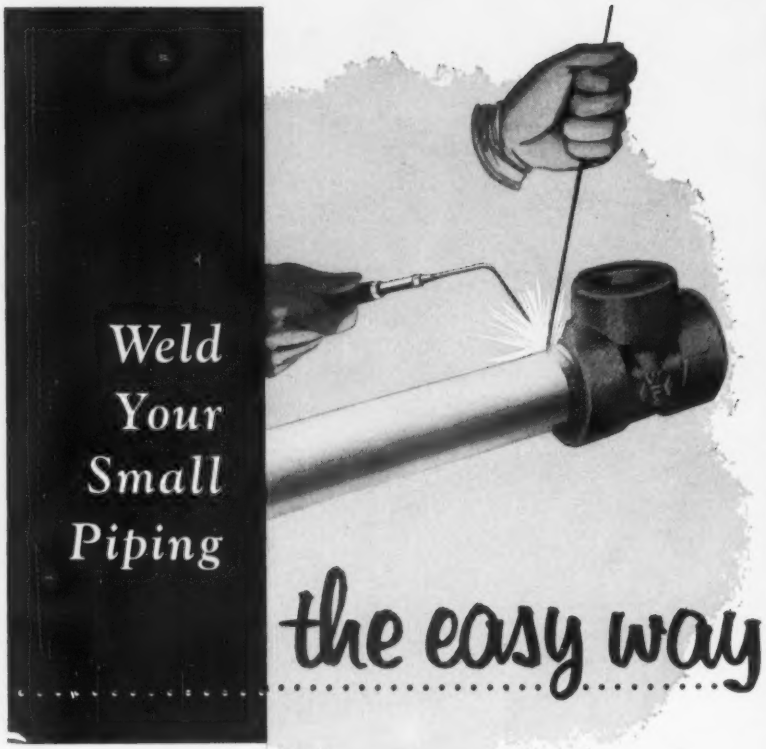

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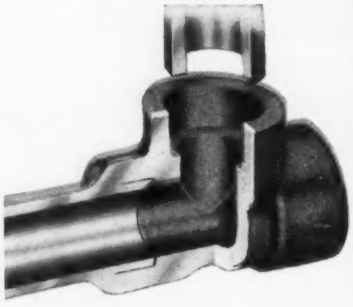

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W-S FITTINGS DIVISION

CONDENSERS

Continued from page 196

that condenser is blocked up.

With a spring-mounted condenser, all connections must be flexible enough to permit free upward and downward movement. Use rubber expansion joints in main circulating-water connections and in condensate pump suction lines. The smaller lines are usually flexible enough to move the necessary amount without strain.

With an expansion joint, the two connected sections tend to move apart or together with a force equivalent to the cross-section area of the pipe in square inches times the difference in pressure inside and outside the pipe in psi. Pipes must be clamped or supported to withstand this force. The expansion joint is ordinarily not built to care for it.

With a pipe under vacuum, such as the exhaust neck of a turbine, a large force tends to pull the condenser upward and the turbine downward. Turbines are ordinarily designed to withstand this downward pull and the exhaust neck is bolted to the foundation or the condenser so it cannot move.

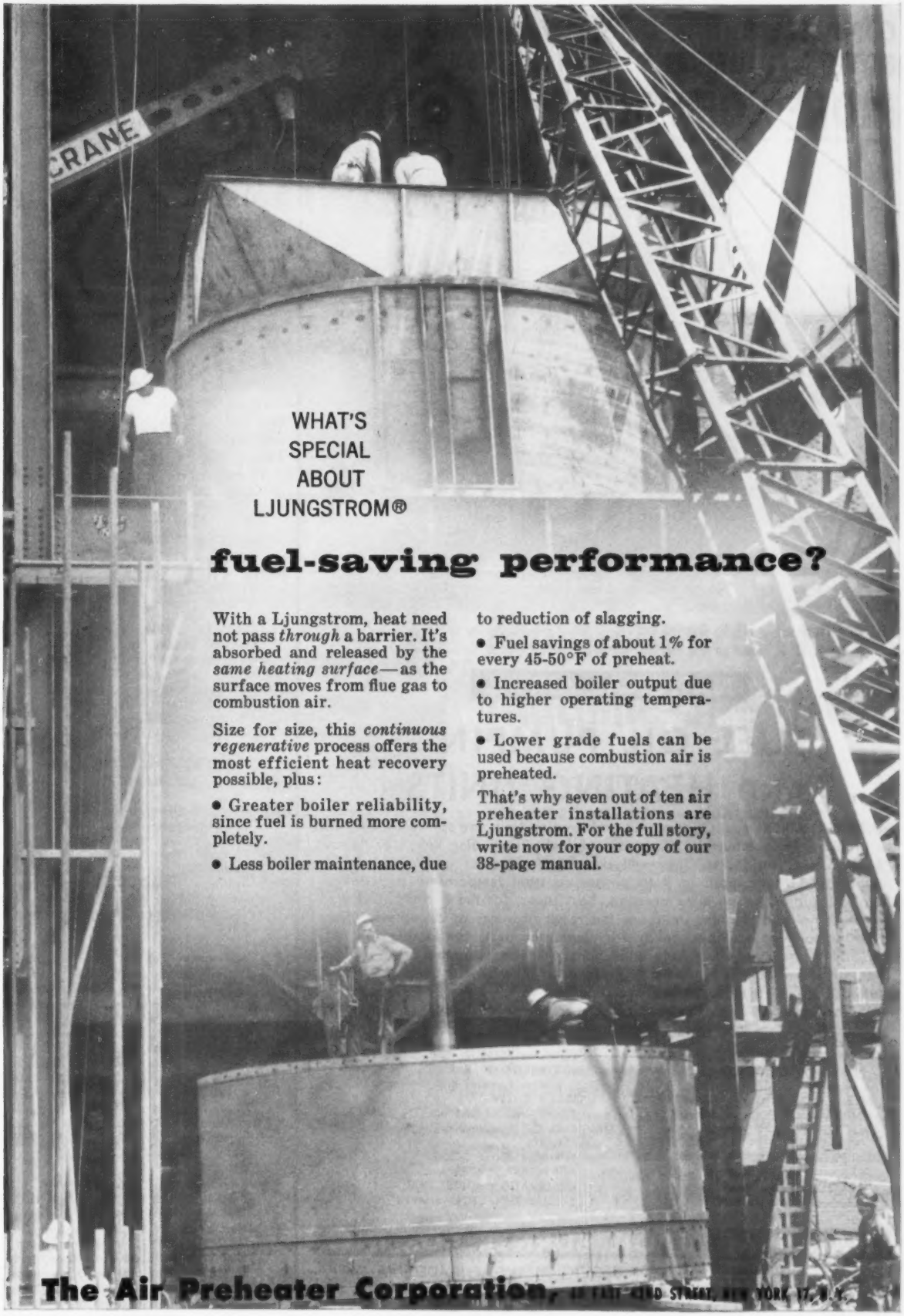
Instrument connections. You need test connections in the condenser exhaust neck. A temperature recorder bulb and a test well are frequently installed. Pressure taps for vacuum gage operation and for turbine and condenser testing are also needed. Install these where steam flow is straight ahead.

A 12 x 12 inch guide plate set parallel to the exhaust neck surface and about 2 inches from it helps avoid impingement or eddying about the pressure opening. This could cause a false reading. Test opening must be smooth and flush with the inner surface of the exhaust neck.

In spite of these precautions, there may be substantial differences in actual pressures at various points across the neck area. For accurate readings, install one test opening for each 16 sq ft of exhaust neck area. You can connect these points to separate instruments or connect them together symmetrically and bring them to a single instrument.

In locating test points, consider corners, braces, reinforcing ribs and internal pipes that might disturb straight line steam flow. These precautions are necessary because of the extremely high steam velocities in the exhaust system.

Waterboxes of a condenser—either cast iron or welded steel plate—must be stayed or ribbed to withstand the circulating-water pressures encountered. Sometimes, when condenser is



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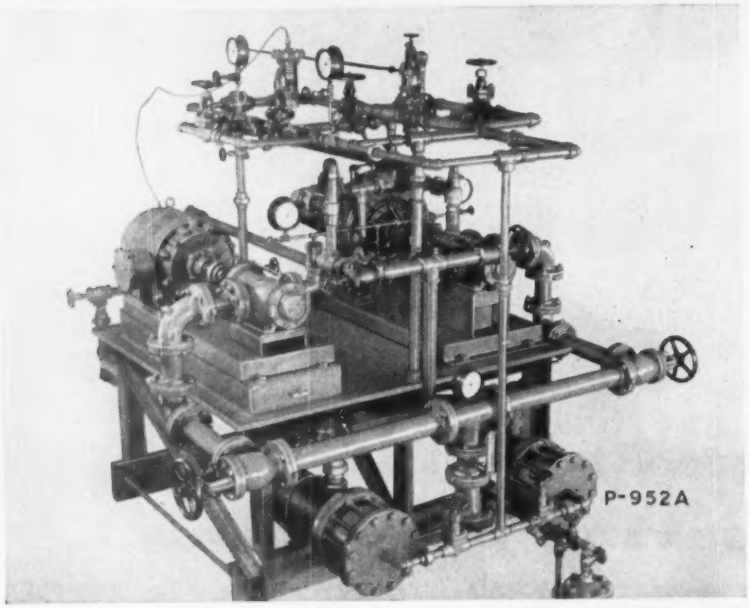

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CONDENSERS

Continued from page 198

set high and pump pressures are low, vacuum may cause a tendency to collapse.

Consider conditions under which the unit will operate when specifying condenser characteristics. Water levels at minimum and flood conditions, head developed at various flows by circulating water pump, flow resistance of circulating water conduits and of condenser, whether a sea well is used in the outlet tunnel, all affect pressures in the condenser and hence determine the suitability of various designs.

Where a cooling tower is used, condenser and circulating water conduits may be exposed to additional head as water is forced over the tower. This may require a more expensive type of construction for condenser and conduits.

Next article in this series deals with problems of starting the condenser.

More FREE LITERATURE

Begins on page 167

operation data, capacity curves, ratios, steam and air consumption tables. Pump priming operation are described, a pump priming capacity chart is included. Dept JA-2, Schutte & Koerting Co, Cornwells Heights, Bucks County, Pa.

CONTROLS, ELECTRICAL & MECHANICAL

11 **Electric thermostat** designed to control temperature and movement of heavy liquids is described in bulletin RT-808. Four-page booklet has installation, application data and diagrams. Robertshaw-Fulton Controls Co, 110 E Otterman St, Greensburg, Pa.

12 **Automatic control system** application to large central station boilers is discussed in 12-p bulletin 1032. Schematic diagrams of systems, illustrations of units are given. Copes-Vulcan Div, Blaw-Knox Co, Erie, Pa.

13 **Photoelectric control** with cats' eye slit is subject of folder. Includes technical data, lists uses for industrial controls. Mason Instrument Co, 27 Elm Ave, Mt Vernon, New York.

14 **Panelboards** are described in 4-p bulletins GEC-1253A and GEC-1255A. Application and descriptive information, construction and selection data are included. Advertising & Sales Promotion, Distribution Assemblies Dept, General Electric Co, Plainville, Conn.

(Continued on page 202)

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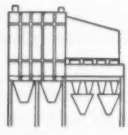

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More FREE LITERATURE

Begins on page 167

15 **Pressure regulators** for control of air or steam at up to 250 lb, 450 F are discussed in 6-p folder. Two pages of tables aid selection; a page of installation diagrams and tips is included. Regulator dimensions are tabulated. Crane Co, 836 S Michigan Ave, Chicago 5, Ill.

ELECTRICAL EQUIPMENT

16 **Current-limiting fuses** are described in 8-p illustrated bulletin GEA-6319B. Includes descriptions, tables, diagrams of fuses capable of interrupting short circuit currents up to 200,000 RMS symmetrical amps. Current characteristics graphically described. General Electric Co, Schenectady 5, New York.

17 **Electric thermostat** for over-temperature protection is subject of 4-p bulletin RT-805. Wiring diagrams, dimension specs, diagram of unit are included. Robertshaw-Fulton Controls Co, 110 E Otterman St, Greensburg, Pa.

18 **Electrical conventions,** meetings and seminars are listed in "daily reminder" calendar. Folder also has page for personal notes, 12-month calendar. Covers period to August, 1958. Kaiser Aluminum & Chemical Sales, Inc, 919 N Michigan Ave, Chicago 11, Ill. Attn: Mr Edward Collins.

19 **Gearmotors** and package drives are described in 8-p illustrated booklet DB-3650. Horizontal, vertical, right angle, open, enclosed, explosion-proof, ac and dc units are listed; reduction ratios and output speeds given. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

20 **Motor starter** and contactor bulletin contains 12 pages of units in sizes 4, 5 and 6; 50 to 400 hp. Illustrated bulletin 14B8615 describes features, construction details. Allis-Chalmers Manufacturing Co, Milwaukee 1, Wis.

HEAT EXCHANGERS, CONDENSERS

21 **Heat exchanger** catalog lists units available for all operations. 16-p booklet has engineering section with technical data; thermal standards and reference data are included in five pages of diagrams. Condenser Service & Engineering Co., 150 Observer Highway, Hoboken, N. J.

22 **Surface condenser** bulletin M-571 includes 4 pages of illustrated descriptions of design and technical features, operation. Southwestern Engineering Co, 4800 Santa Fe Ave, Los Angeles 58, Calif.

23 **Heat exchanger** costs are listed in booklet. Design and cost booklet contains rapid analysis of comparable costs in specific applications. Wolverine Tube, Guardian Towers, Guardian Building, Detroit 26, Mich.

...more quality proved POWELL VALVES

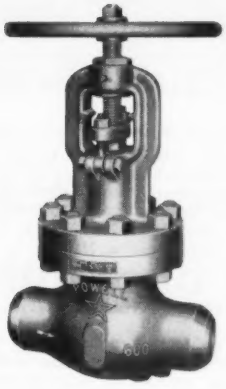


Fig. 6031S-WE—600-Pound Steel Globe Valve for Steam Service. Outside Screw Stem and Yoke.

Fig. 19003—Powell Steel Pressure Seal Gate Valve for 900 Pounds W.S.P.

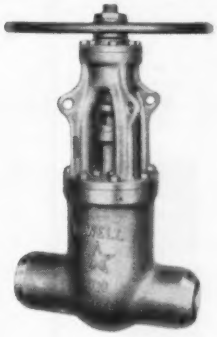


Fig. 2467—Small 300-Pound Stainless Steel O.S.& Y. Gate Valve. For handling boiler feed water treating solutions.

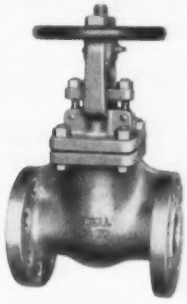


Fig. 1793—Iron Body Bronze Mounted O.S.& Y. Gate Valve for 125 Pounds W.S.P.

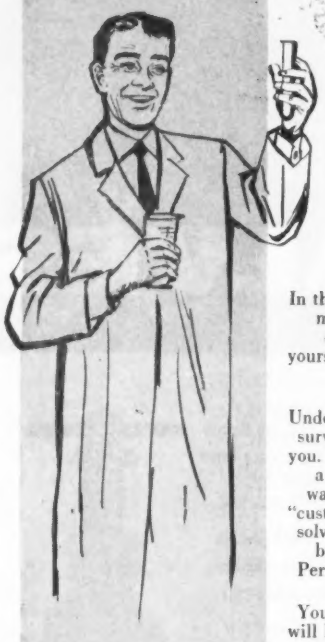
made with quality proved materials

Consult your Powell Valve Distributor for full facts about quality proved bronze, iron, steel, and corrosion-resistant valves. For every flow control problem—there is a Powell Valve to solve it . . . *better.*

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

Eliminate Boiler Feedwater Problems with DEADY

DEADY Products, Recommendations and Service



There's only one way to keep your boiler feedwater operation efficient. That's by preventing and/or correcting water problems by thorough analysis and investigation of the "problem". Deady Chemical Company has been a specialist in individualized treatment of water problems since 1905.

In that time, Deady engineers have met and mastered every type of industrial water condition and problem. You can avail yourself of Deady's formulated products and specialized know-how through the Deady Service Plan.

Under this plan, Deady Service Engineers survey your particular needs at *no cost* to you. As part of their survey, they will make a complete laboratory analysis of your water supply. After thorough study, the "custom-made" Deady Recommendations to solve your water conditioning problem will be presented to you without obligation. Periodic Deady *Service* "Check-ups" make sure your water is properly treated.

Your small investment in Deady products will be repaid many times over in the plant protection you'll receive. Why not write for the illustrated folder describing the Deady Plan in detail? No obligation, of course.

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Say: DEE-DEE

DEADY CHEMICAL COMPANY

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Kansas City 15, Kansas

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3757 Wilshire Boulevard
Los Angeles, California

Field Service Engineer Headquarters:

Kansas City, Kans.
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Chicago, Ill.
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Davenport, Iowa
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Indianapolis, Ind.
Fort Wayne, Ind.
Cincinnati, Ohio
Toledo, Ohio
Denver, Colo.
Tulsa, Okla.
Los Angeles, Calif.
San Francisco, Calif.
Seattle, Wash.
Pittsburgh, Pa.
Memphis, Tenn.
Chattanooga, Tenn.
Charlotte, N. C.

More FREE LITERATURE

Begins on page 167

★ **Power connector** tabbed catalog has 130 pages listing all connectors. Catalog 1 includes eight sections, 158 types of units, over 700 items. Data section aids in estimating, planning. Includes tables and charts. ★Request direct on company letterhead. Royal Electric Manufacturing Co Inc, 1122 E 87 St, Chicago 19, Ill.

MAINTENANCE EQUIPMENT & MATERIALS

24 **Protective closures** are subject of 4-p catalog. Includes specs for rubber and plastic closures for protection, sealing or masking of threaded parts, pipe ends or tubing. Specs cover seven stock sizes. Shurclose Seal Co, 3000 E Grand Boulevard, Detroit 2, Mich.

25 **Concrete floor** maintenance program is discussed in 4-p folder. Lists, illustrates equipment and techniques for treating old and new floors. Multi-Clean Products, Inc, St. Paul 16, Minn.

26 **Plastic coatings** fluidized for corrosion resistance are treated in a special 6-p report. Discusses and illustrates mechanism of fluidization, coatings available, cost factors, applications. Tables give data on corrosion resistance, fluidized coating materials. American Agile Corp, Box 168, Bedford, Ohio.

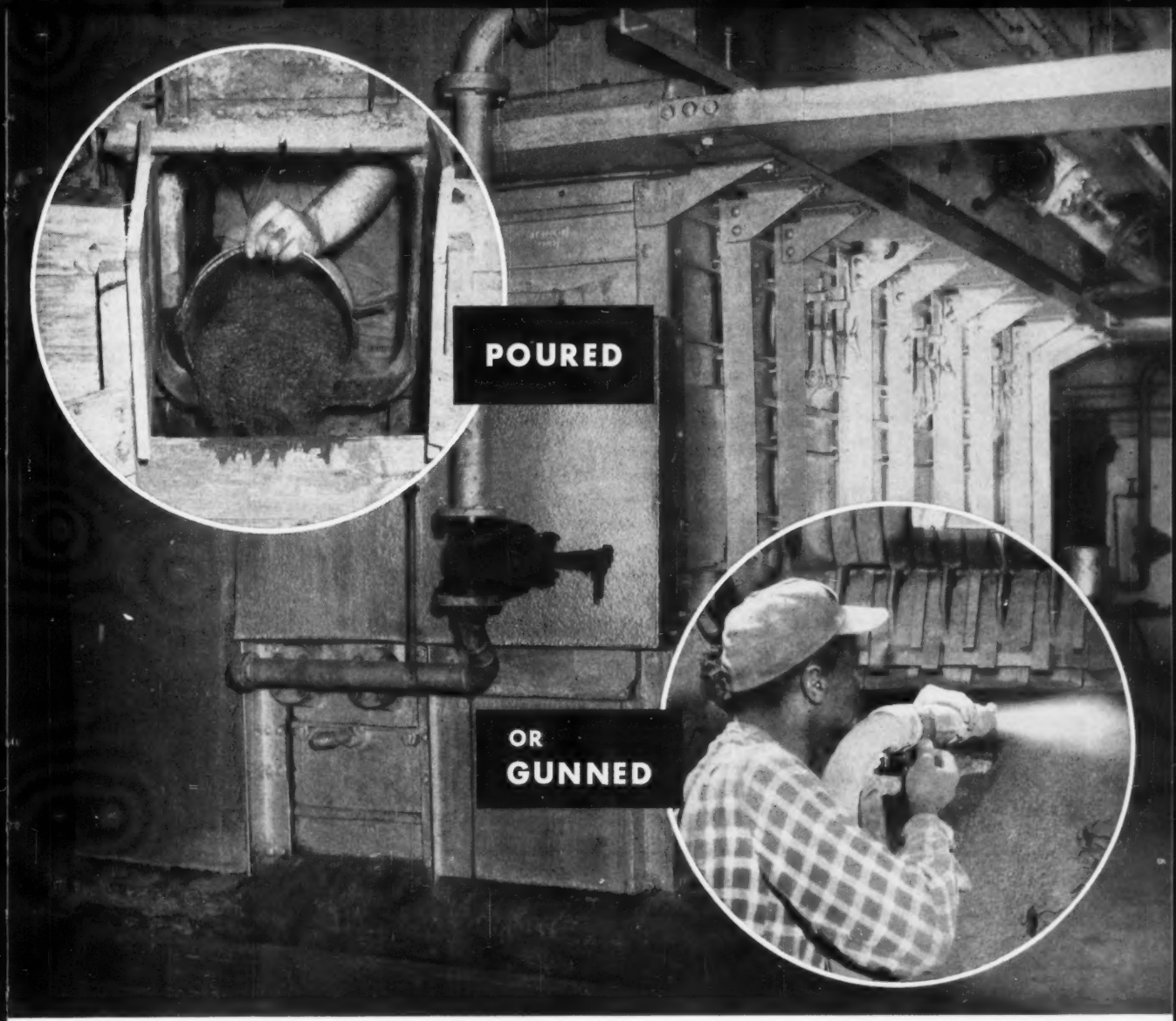
27 **Power sweeper** models are described and illustrated in folder. Sweepers with coverage up to 48-in. are listed. Modern Power Sweeper Co, 738 N McKeever Ave, Azusa, Calif.

28 **Work techniques** to reduce cleaning and maintenance costs are explained in 28-p illustrated handbook. Prepared by methods engineering firm. Advance Floor Machine Co, 4100 Washington Ave, North, Minneapolis, Minn.

MATERIALS HANDLING

★ **Speed reducers** are subject of 40-p catalog SB-517. Contains design features, specifying and ordering information, selection tables, service factors and arrangements, dimensions, hp ratings, and parts lists. ★Request direct on company letterhead. Philadelphia Gear Works, Inc, Erie Ave & G St, Philadelphia 34, Pa.

29 **Steel hubs** and malleable split taper bushings are subject of 4-p catalog HB-101-A. Ten stock sizes, three made-to-order sizes are described and illustrated. Complete specifications, typical applications are included. Browning Manufacturing Co, Maysville, Ky.



B&W Kaocrete Refractory Castables withstand punishing ashpit service

Continuous or intermittent sprays, high velocity water jets for ash removal, rakes and shovels — all these are responsible for the heavy abrasive and erosive attack on ashpit linings. But you can cut the frequency of maintenance and expensive relining jobs by using heavy-duty refractory castables which can be poured or gunned in place.

Specially designed for ashpit service, B&W Kaocrete D has the strength and hardness needed to stand up under these severe conditions. It has unusually high resistance to abrasion, erosion and spalling. Widely used in all types of boiler ashpit hoppers and slag tanks, Kaocrete D has proved its economy and durability. Where abrasive and erosive conditions are less severe, B&W Kaocrete A will give satisfactory service.

Your local B&W Refractories Engineer will be glad to give you complete details on the performance of these B&W Refractory Castables.

Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

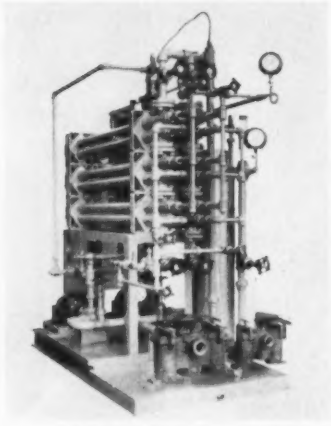
B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

R548

LOCKETT FUEL OIL PUMPING AND HEATING SETS



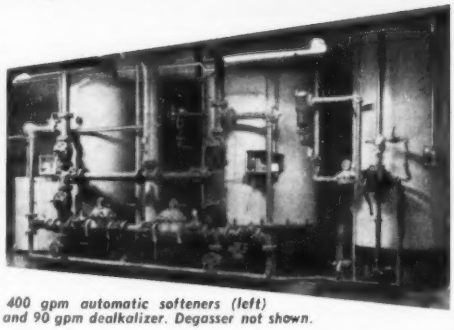
A standard Duplex Pumping and Heating Set, consisting of two Electric Driven Rotary Pumps, with Griscom-Russell Twin G-Fin Heaters and an Automatic Electric Heater, complete with pressure and temperature controls. Completely piped, wired and tested in our shop.

For more than a half-century, Lockett has been supplying standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Various types of pumps are available: Turbine or Motor-Driven Rotary Pumps, Electric-Driven Rotary Pumps, and Duplex Steam Pumps, in any combination. Units can be furnished for any capacity or pressure desired; complete with Strainers, Pressure and Temperature Controls, and Instruments. Each pump is suitable for the full rated capacity of the Unit; one pump and one heater are spares. Engineered to your requirements. Completely assembled and shop-tested. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
NEW ORLEANS • HOUSTON • DALLAS

Complete DEMINERALIZATION is *NOT* always the answer!

DEALKALIZED water for boiler make-up, plus soft water for general plant use was recommended by HMM engineers as adequate for the needs of a large Midwestern dairy. Operating on the principle of solids reduction rather than complete deionization, it has proved an excellent method of treating the high bicarbonate water for their low pressure boilers where silica removal was not essential. Original investment and operating costs have proved considerably lower than complete deionization, which was found unnecessary.



400 gpm automatic softeners (left) and 90 gpm dealkalizer. Degasser not shown.

SYSTEM FEATURES

. . . softeners automatically regenerate
. . . manual dealkalizer, available automatic
. . . adjustable T.D.S. and alkalinity residual standards
. . . controller alarms and removes system from service automatically if substandard water is produced

SYSTEM RESULTS

. . . reduced scale formation
. . . protection against return line corrosion
. . . improved boiler operation in terms of reduced total solids, alkalinity, and softer water.

GOT A WATER TREATMENT PROBLEM?

HMM custom engineering often as not means a lower cost method of treating water. The correct plant for the job requires a thorough knowledge of the water's end-use, raw water characteristics, and the methods of treatment available. Contact us on your water purification problems, whether power or process water. A request on your letterhead will bring our Fact-File-Folder.

H. M. MUELLER CORPORATION
3342 GORHAM AVE., MPLS. 26, MINN.

More EQUIPMENT NEWS

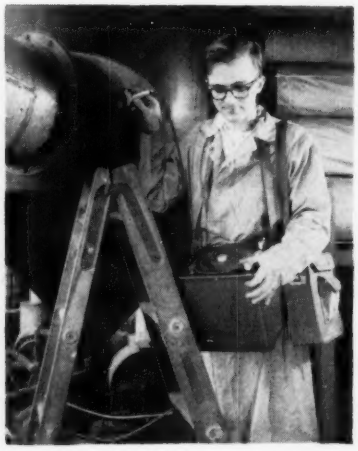
Begins on page 158

Delay line

1031 • Continuously variable line is designed for use as a component or as test equipment in advanced computer and radar systems.

According to manufacturer, line offers maximum in application flexibility. Attenuation is 2.5 db. Resolution is better than 1/1000 of maximum delay. Termination is external. Maximum delay is 4.0 usec. Maximum rise time is .76 usec. Impedence is 220 ohms. Outside dimensions are 7¼ x 1 x 1⅝.

ESC Corp, 534 Bergen Blvd Palisades Park, N. J.



Thickness-measuring unit

1044 • Completely portable, battery-operated unit for nondestructive testing measures thickness, locates corrosion and wear on storage tanks, pipes and other structures accessible from only one side.

Operator selects range, places probe on test area, adjusts and reads dial. Testing unit is said to measure thicknesses up to 4 in. with ±3% accuracy, requires no warm-up time, works on rigid materials —most metals, glass, hard insulators.

Magniflux Corp, 7300 W Lawrence Ave, Chicago 31, Ill.

For more details on these items, use post cards p 167. Identify your request with item number.

Plug-in circuit breaker

1022 • Twin plug-in circuit breaker makes it possible to install up to twice the number of circuits normally possible, according to manufacturer.

Introduced at the same time is a line of circuit breaker load centers in main ratings from 40 to 200 amps and from 2 to 40 branch circuits.

Unit is available in ratings of 15 and 20 amps and is suitable for use in protecting ac lighting and appliance branch circuits. Handle extensions are available for combining two adjacent breakers for 2-pole

New Edward Instrument Valve *with integral hard-faced seat ends corrosion-erosion problems!*

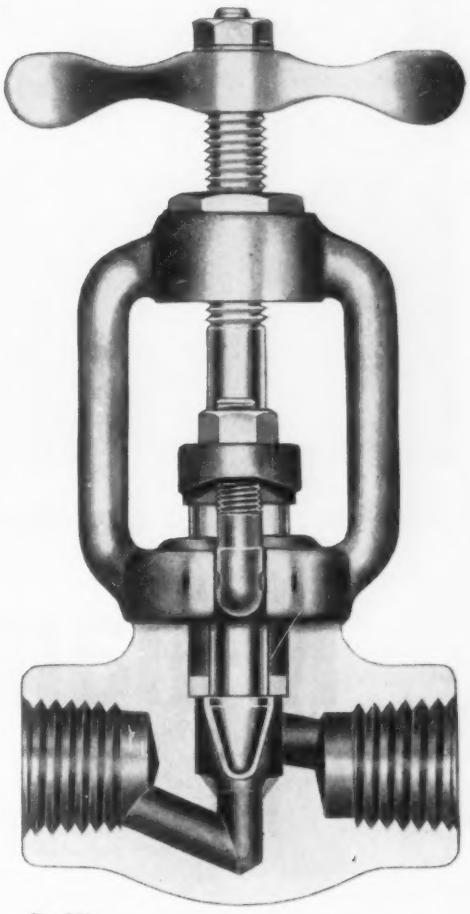


Fig. 952

Used to be, you had to choose between valves of stainless steel—which were difficult to weld into carbon steel pipelines—and valves of carbon steel, which soon corroded and began to leak around the seat. Scientists in the Research Laboratories at Edward Valves, Inc., have been hard at work on this common, costly, irritating problem. And—as usual—they have come up with the solution.

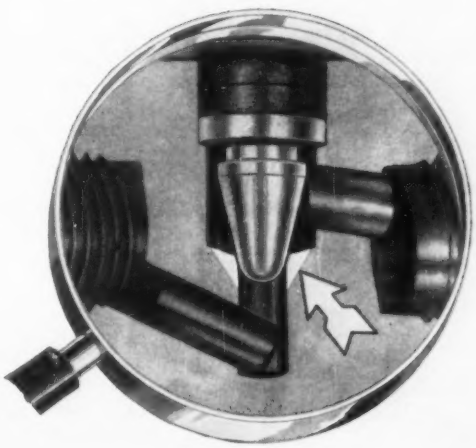
Valve seat now hard-faced with cobalt-chromium-tungsten alloy

This new Edward instrument valve combines a carbon steel body with a cobalt-chromium-tungsten seat face for long, dependable, corrosion-resistant life. *The seat is integral with the body to eliminate leak problems.* Precision machining of the alloy seat—in the same set-up as the body bore—is followed by careful lapping to form drop-tight mated seating faces with 100% bearing surface. The carbon steel body permits easy, efficient welding into carbon steel pipelines. Screwed ends are also available.

Precise flow control

Precise flow control is achieved by tapered needle point stem disk and fine pitch screw threads. This new Rockwell-built Edward instrument valve meets the need for a small, compact stop and variable flow valve for high-pressure, high-temperature service. Rated at 2500 lb. at 850F., the new valve is ideal for all power plant instrumentation. The stainless steel body line will continue in production for applications requiring extreme corrosion resistance.

For further information on the new Edward instrument valve, write for Bulletin 571.



Edward Valves, Inc.

Subsidiary of

ROCKWELL MANUFACTURING COMPANY

1230 WEST 145TH STREET, EAST CHICAGO, INDIANA

Wears longer than steel . . . non-skid under oily conditions . . .

Reliance Relgrit®

abrasive embedded grating

Reliance Relgrit abrasive embedded grating and treads provide the only truly non-skid surface. Even when covered with oil, Relgrit has a coefficient of friction 30% greater than dry steel grating. Wear tests have shown that the abrasive surface will wear longer than steel, and retain its non-skid quality during its entire service life.

The top surfaces of the bearing and cross bars have ⅛" deep V-grooves in which is embedded abrasive aluminum oxide grains in a hard resin. The material is not affected by water, oil, gasoline, greases, or commonly used acids, alkalis and other chemicals. Together with its wear resistance, this gives Relgrit a long service life.

If you have floors or stairs which become oily, greasy, wet, or slick from any cause, Relgrit can provide safe footing at very low cost. Write on your letterhead for free sample and literature, or ask for our representative to call. It will pay you to investigate this remarkable new grating.

*you can't slip on Relgrit**

*Patent applied for

Please send Bulletin R655B describing Relgrit abrasive embedded grating and treads.

NAME

COMPANY

ADDRESS

CITY STATE

RELIANCE
Steel Products Company

P.O. Box 510-J, McKeesport (Pittsburgh District), Pa.

Relgrit Abrasive Gratings and Treads • Lightweight Bridge Flooring
Steel, Stainless and Aluminum Grating • Steel Mill Equipment

LARSON-LANE STEAM AND CONDENSATE ANALYZERS

FOR ACCURATE MEASUREMENT OF STEAM CONDUCTIVITY

MOST modern and efficient system of removing volatile amines, ammonia and carbon dioxide prior to recording steam conductivity. This thoroughly effective steam degasser uses a cation exchange resin for the removal of ammonia, morpholine, cyclohexylamine, and reboiling for the removal of CO_2. Constant sample temperature is maintained. Taps provided for drawing sample for other analyses.

Larson-Lane Steam and Condensate Analyzers make possible rapid and accurate measurement of steam purity, completely essential for efficient boiler operation.

A smaller, less expensive unit, the CH-16 provides for removal of ammonia and amines from steam condensate without the necessity of reheating. Condenser leakage is readily detected with this model in the presence of volatile amines or ammonia.

Write today for complete technical details.

Industrial Instruments Inc.
89 Commerce Road, Cedar Grove, Essex County, N. J.

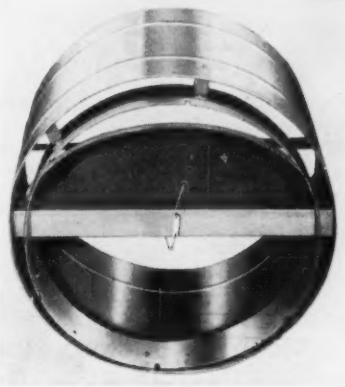
More EQUIPMENT NEWS

Begins on page 158

operation. UL approved, the unit has an interrupting rating of 5000 amps ac.

Line of load centers available in flush, surface and rain-tight enclosures, will be shipped with fronts in place to eliminate excessive catalog numbers. The front hooks on and can be fastened into place by tightening two captive screws.

General Electric Co
Plainville, Conn.



Emergency damper opener

1040 • Emergency vent unit is designed as fire safety factor in sprinkler systems for one-story plants. Unit is independent of fan operations, helps speed up escape of smoke and fumes.

Safety vent is automatic; controlled by single spring held in tension by a fusible link. Heat breaks link, releasing spring which raises ventilator dampers. Special feature according to manufacturer: spring is shielded from flames by damper blades, lessening danger of annealing and loss of tension. Request details.

Chicago Blower Corp
9863 Pacific Ave, Franklin Pk, Ill.

For more details on these items, use post cards p 167. Identify your request with item number.

High-strength stud line

1026 • Studs are suited for power-plant steam turbines, nuclear reactor equipment and a variety of other high-temperature high-pressure fastening jobs. Units range in size from ½ to 6 in. in diameter and from 6 to 72 in. in length. Some weigh as much as 800 lb.

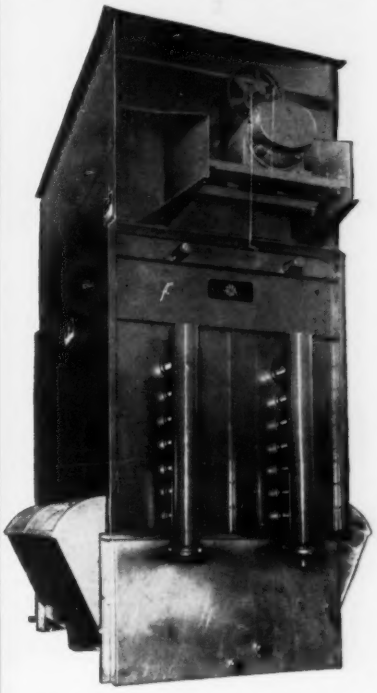
Standard Pressed Steel Co
Jenkintown, Pa.

Boiler scaffold

1042 • Scaffold is said to provide complete boiler coverage for construction or repair, allow communication between man in boiler and outside operator.

Big advantages, it is claimed, are in easy, safe operation. Scaffold is rapidly installed and moved, may be dismantled

This AIR-COOLED CONDENSER *produces a* HIGHER VACUUM



● Using air as the cooling medium, the Niagara *Aero* Vapor Condenser produces a higher vacuum than other type condensers, and with more enonomy of power and steam.

It sustains its full capacity in cooling or condensing with no more than a nominal cooling water requirement, eliminating entirely your problems of water supply and disposal.

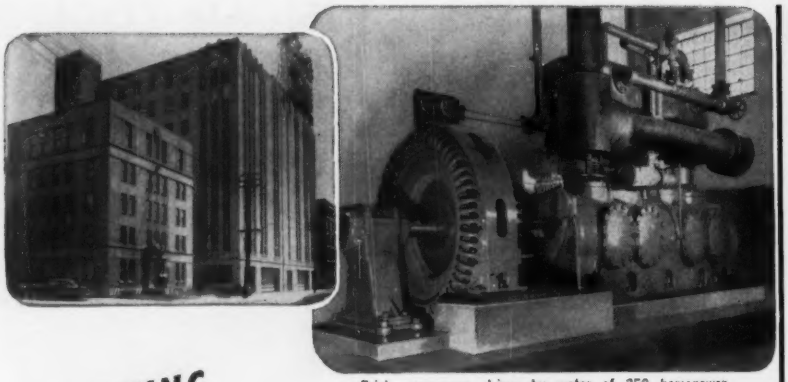
It holds constant the liquid or vapor temperature producing always uniform products and giving maximum production.

Non-condensibles are effectively separated at the condensate outlet, with sub-cooling, after separation for higher vacuum pump efficiency.

Niagara *Aero* Vapor Condenser can be mounted directly on the steel structure of your evaporator or distillation column. Its operation is dependable; its maintenance is not troublesome or expensive.

For more information write for Bulletin 129R

NIAGARA BLOWER COMPANY
Over 35 years of Service in Industrial Air Engineering
Dept. P-10, 405 Lexington Avenue
NEW YORK 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada



Frick compressor, driven by motor of 350 horsepower, at Victoria Street plant of O'Keefe Brewing Co.

SERVING TORONTO'S LARGEST BREWERY—

The two plants of O'Keefe Brewing Co. Ltd. in Toronto (a subsidiary of Canadian Breweries Ltd.) use four large Frick refrigerating machines. These ammonia compressors were installed by J. H. Lock & Sons, Frick Distributors for Ontario.

All told, 37 Frick compressors are operated by Canadian Breweries Ltd. and its American subsidiary, the Carling Breweries.

If you, too, need a reliable cooling system for your business, get in touch with the firm having 75 years of refrigerating experience.

FRICK COMPANY, WAYNESBORO, PENNA.

TRADE FRICK MARK® Refrigeration

PET-RE-NOL

FUEL OIL CONDITIONER

Get More BTU's — Keep Burners Clean

PET-RE-NOL aids efficient combustion and lowers fuel costs by bringing about more complete use of the Btu potential of the fuel. Keeps burners clean because it (1) dissolves SLUDGE, (2) suspends and disperses CARBON to burn at burner tips, (3) emulsifies the MOISTURE in storage tank, (4) retards GUM deposits, and (5) prevents CORROSION. Used and recommended by more maintenance engineers than any similar product. UNCONDITIONALLY GUARANTEED!

SEND THE COUPON

for FREE testing sample and booklet of engineering data

TEST PET-RE-NOL at our expense

NORMAN CHEMICAL CO.
1630 Carroll Ave., St. Paul 4, Minnesota

Send us FREE TESTING SAMPLE of PET-RE-NOL and booklet of engineering data.

Firm .....

Address .....

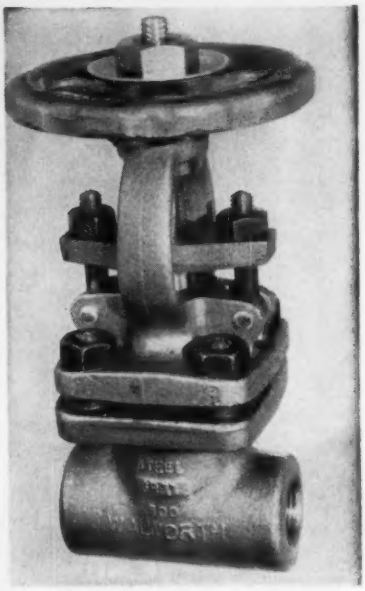
City ..... State.....

More EQUIPMENT NEWS

Begins on page 158

for storage. Grill construction makes unit self-cleaning. Details from manufacturer.

Atlas Industrial Corp
849 38th St, Brooklyn, N. Y.



Steel-wedge gate valves

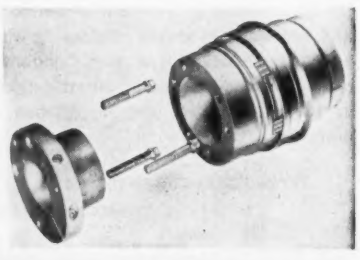
1034 • Valves are suited for water, steam, gas or air service at temperatures up to 850 F and for oil vapor up to 1000 F.

Valve body is of forged carbon steel. It has a nonshock pressure-temperature rating of 420 psi at 1000 F and a rating of 2000 psi at 100 F. Stem, wedge and seat rings are made of 13% chromium stainless steel for longer service life.

Valves are available with screwed or socket welding ends. Those with a union bonnet are available in eight sizes from ¼ to 2 in.; those with bolted bonnets, in six sizes from ½ to 2 in.

Walworth Company
60 E 42nd St, New York, N. Y.

For more details on these items, use post cards p 167. Identify your request with item number.



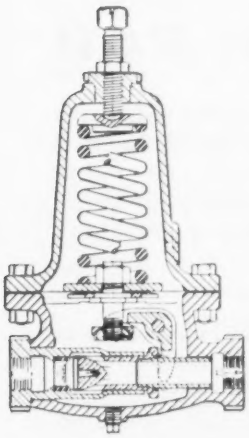
Flexible couplings

1046 • Couplings are taper-bored for use with *QD* bushings, afford easy fastening to shaft with firmness of shrunk-on fit. Six

For better molded products...

CASH STANDARD type 1000 VALVES

keep mold temperatures in the "Safety Zone"



In the production of molded parts, uniform quality is assured through careful control of time, temperature, pressure and other factors in the molding cycle.

A leading producer of precision molded plastics parts is General Electric Company's Plastics Department, Decatur, Ill. On G-E's compression molding machines, almost 200 Cash Standard Type 1000 Reducing Valves are in use, keeping mold temperatures constant by controlling the steam supply.

Donald F. Thompson, G-E's Supervisor of Plant and Facilities Engineering, says: "For our particular application, where we use a large number of reducers, it is essential that the initial cost and maintenance cost be held to a minimum. We have found that Cash Standard 1000's have done the job very effectively."

The unique construction of this valve provides high capacity and accurate control of steam, water, air, oil and most gases and chemicals. Exclusive streamlined inner valve eliminates turbulence; flow through valve housing is in a straight uninterrupted line; an aspirating effect controls valve opening by amplifying slight pressure changes into large valve operating forces.

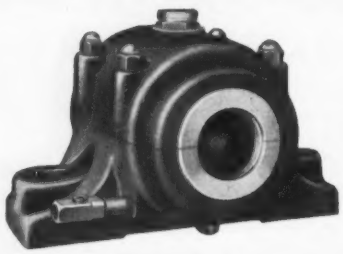
What's *your* control problem? Contact the Cash Standard control specialist in your area for more information on this unusual valve and other Cash Standard control products, or write Dept. E.

CASH C S **STANDARD**

A. W. Cash Co. and Its Subsidiary, Cash Standard Stacon Corp.
P. O. Box 551, Decatur, Ill.

Pressure, Hydraulic, Temperature, Process and Combustion Controls

Bright Lights–That Never Fail



SLEEVOIL BEARINGS

Dodge Sleevoil Bearings are available in plain type or water-cooled. They are self-aligning. Can be drilled for thermostatic emergency warning if desired. Shaft sizes from 1-7/16" to 10".

The brilliant lights of Broadway match the stars in the certainty of their rising. A black-out from power failure is almost unthinkable.

One factor that contributes to the dependability of this steady power supply is the bearing that insures unfailing operation of mechanized draft in the generating plant.

These Bearings are Dodge Sleevoil.

Generating plants throughout America—including those in such metropolitan centers as New York, Detroit, San Francisco, Los Angeles—use these super-quality bearings.

The Sleevoil Bearing is a Dodge development, created especially to meet the exacting requirements of fan and blower service. You are invited to write us for our new Engineering Catalog D56, which contains detailed description, sizes, dimensions.

DODGE MANUFACTURING CORP., 3200 Union St., Mishawaka, Indiana

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on modern power transmission machinery for *modern* installations. Look for his name under "Power Transmission Equipment" in your classified telephone directory.

DODGE

of Mishawaka, Ind.

More EQUIPMENT NEWS

Begins on page 158

different sizes range from 22 to 150 hp at 1750 rpm. Immediate availability of wide range of shaft sizes from reduced stock is cited as big advantage.

Lovejoy Flexible Coupling Co
4896 W Lake St, Chicago 44, Ill.

Mixer-disperser

1051 • Unit combines mixing advantages of a diamond-shaped agitator, rotating on its angular axis, with the mulling, shearing and impinging action of a revolving disperser head.

Turning at 3600 rpm, disperser head forces the material into mulling zone and out towards the sides of the rotating change can—where it is again swept into the agitator blade and the mixing-dispersing cycle is repeated. Thus, the entire batch is agitated, agglomerates are broken and mulling action is complete—dead spots and stratification are eliminated, according to maker.

Troy Engine & Machine Co
703 Parsons St, Troy, Pa.

For more details on these items, use post cards p 167. Identify your request with item number.

Polyethylene tank liner

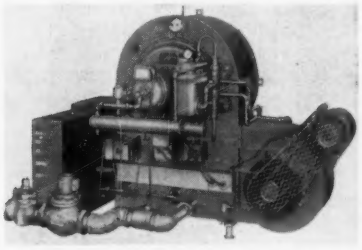
1045 • Tank liner solves problem of in-plant handling of corrosive liquids in steel containers. Product is designed for flat-bottom cylindrical tanks with no inside metallic welds. Applications include acid storage, metal cleaning, degreasing.

Liner comes pre-installed in tank; can be fabricated to buyer's specification.

American Agile Corp
5461 Dunham Rd, Maple Hgts, Ohio

Correction

In the July issue of Power on page 166, the following picture was mistakenly placed over an item on Robertshaw-Fulton Control Co's vibration monitor system. It is actually a forced draft burner manufactured by the Ray Oil Burner Co. The two items with their respective pictures appear below.

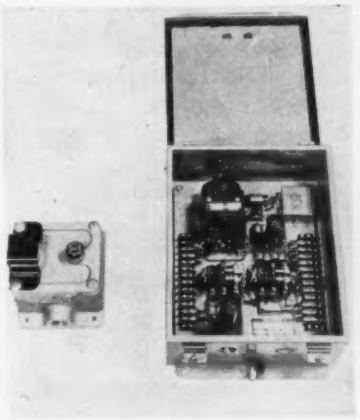


Forced draft burner

1052 • Packaged unit, factory assembled is designed for combination with any type boiler for forced draft operation. Forms an automatic packaged boiler-burner unit, for high or low pressure steam or hot water heating, with maximum rated capacities from 80 to 750 developed output hp.

Burner specifications may be selected to burn any grade of fuel oil from light No. 2 to heavy No. 6, high or low pressure gas, or combination units burning either gas or oil. Details from manufacturer.

Ray Oil Burner Co, 1301
San Jose Ave, San Francisco, Calif.



Vibration monitor system

1050 • Non-electric system is said to be sensitive to increases in vibration yet to ignore both starting vibration and transient shocks normal to operation.

System combines malfunction detector, for mounting on protected equipment, and control unit which is wired to detector through ¾-in. conduit.

Malfunction detector is designed for use in Class I, Group D; and Class II, Groups F and D locations. Control unit is oil-tight and is installed in a non-hazardous location unless connected with an airline using an optional air-purge fitting.

Applications include the protection of pumps and motors, blowers, compressors, centrifuges, engines, turbines and other costly equipment.

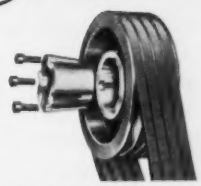
Robertshaw-Fulton Controls Co
2920 N 4th St, Philadelphia, Pa.

Danger signal bull plug

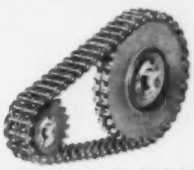
1027 • Units, with their red bands, are said to pinpoint the locations of dangerous openings in piping lines. They are easily seen and give immediate warning that unsafe conditions or fire hazards exist, according to manufacturer.

Unit incorporates a permanently attached chain and ring at the unthreaded end to prevent loss. Ring may be used to circle valve or piping, or chain may be spot welded to line. It is available in steel and stainless steel in a range of sizes from ¼- to 2-in. pipe.

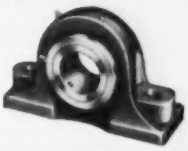
Crawford Fitting Co
884 East 140th St, Cleveland, Ohio



TAPER-LOCK
SHEAVES
Easy on—easy off! Mount flush!



TAPER-LOCK
SPROCKETS
No reboring—no waiting!



SC AND SCM
BALL BEARING PILLOW BLOCKS
"The seal won't blow!"

Write for Bulletins!

- Taper-Lock Sheaves. Drive tables and technical data. Bulletin A-661
- Taper-Lock Sprocket and Dodge Roller Chain data. Bulletin A-644
- Rolling Bearings—SC, SCM and Dodge-Timken. Bulletin A-638

DODGE MANUFACTURING CORPORATION
3200 Union Street • Mishawaka, Indiana

DODGE
of Mishawaka, Ind.

CONSTRUCTION FEATURES ---

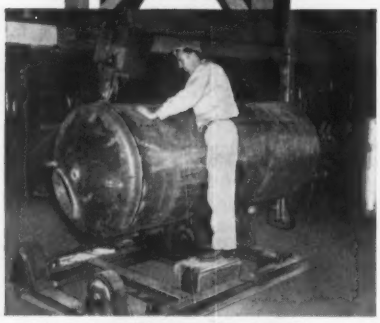
PLUS CONTROLLED QUALITY

make Your Choice of the

L★A Deaerator

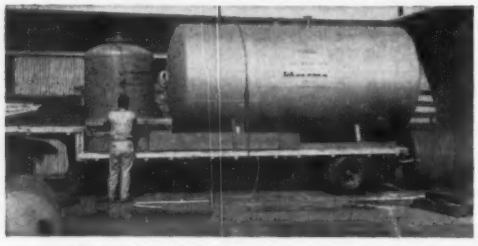
a Wise One indeed!

- Always completely assembled in our own shop
- Always fabricated by our own skilled employees
- Constantly supervised by our own engineers
- Fabricated of highest quality materials
- API-ASME approved shop
- Always a final check-out of assembled unit
- One complete bulk shipment
- Jet atomizing, tray and combinations available
- All stainless steel internals
- Self-adjusting to all loads
- 10,000 to 2,000,000 lbs. per hr. capacities



Automatic welding machine in L*A shop

From your initial inquiry through the shipment of the completed deaerator, L★A Water Softener Co. takes complete responsibility. You are assured of the finest workmanship and control with constant inspection and supervision by our qualified engineers as fabrication and assembly proceed. Consistant top quality equipment is the result.



100,000 lbs. per hr., 10 min. storage unit being loaded for delivery to eastern chemical manufacturer

You KNOW where your L★A Deaerator is made! And this complete control from one source enables L★A to deliver **on schedule** and ready for quick installation.

May we send you a copy of our new Deaerator booklet? Simply ask for Bulletin 102-A

L★A WATER SOFTENER COMPANY

1007 Air Way, Glendale 1, California

REPRESENTATIVES IN PRINCIPAL CITIES

Demineralizers • Hot Process Softeners • Floc Treators • Deaerators • Zeolite Softeners • Dealkalizers

More TECHNICAL BRIEFS

Begins on page 154

hazards and equipment that carbon-dioxide systems may satisfactorily protect include: (1) gaseous and liquid flammable materials (2) electrical hazards, such as transformers, oil switches, and circuit breakers, rotating equipment (3) engines utilizing gasoline and other flammable fuels (4) ordinary combustibles, such as paper, wood and textiles (5) hazardous solids.

There are five types of carbon-dioxide systems recognized in these Standards: total-flooding systems, local-application systems, extended-discharge systems, hand-hose-line systems, standpipe systems and mobile supply. *NFPA pamphlet No. 12.*

Standard for the installation, maintenance and use of portable fire extinguishers, May, 1957. *By National Fire Protection Association.*

This standard applies to installation, maintenance and use of all fire-extinguishing equipment and devices that are portable in their entirety. It does not apply to permanently installed systems for fire extinguishment even though portions of such systems are portable.

Items covered include: portable fire-extinguisher classification; distribution of units; standard fire pails; soda-acid, water type, wetting-agent, foam, loaded-stream, vaporizing-liquid, carbon dioxide and dry-chemical extinguishers; metal fires, hydrostatic test procedure. *NFPA pamphlet No. 10.*

Standard for water-spray systems for fire protection, May 1957. *By National Fire Protection Association.*

This standard sets the major types of water-spray systems used for (1) extinguishment (2) control of fire (3) exposure protection (4) fire prevention. The first step in considering water spray is to determine which one or more of these four major purposes will apply. The type of nozzle, amount of water required, unit rate of discharge, nature and extent of coverage and drainage are factors that will vary with the purpose of the system.

Water-spray systems are particularly effective on most flammable liquid fires; they are also effective on most of the combustible solids and on fires in electrical equipment. The type of water-spray system required for any particular hazard depends on nature of the hazard and form of protection desired.

Although water spray has a wide ap-

Directions for ordering papers on page 220

A SUPER HYBOND arch was installed in a B & W coal fired boiler, with a chain grate stoker, in an Indiana Municipal light plant. The boiler is rated at 125,000 lbs. per hour, and operates at about 200% of rating. Prior to the use of SUPER HYBOND it was necessary to replace the arch in this boiler every 9 months. The SUPER HYBOND arch was not replaced for 3½ years and even then, as shown by the photos, could have given additional service.

SUPER HYBOND arch as installed.

A.P. GREEN

Super Hybond Suspended Arch Gives More Than 4 Times the Service of Previously Used Refractory Arch

SUPER HYBOND arch after 3½ years' service.

SPECIFY A. P. GREEN PLASTIC FIREBRICK LININGS for longer life . . . lower maintenance costs

For over 30 years, A. P. Green plastic firebrick, made from highest quality Missouri fire clays, has been proved in service. Four grades of plastic to meet varying refractory needs.

warehouse stocks for prompt shipment

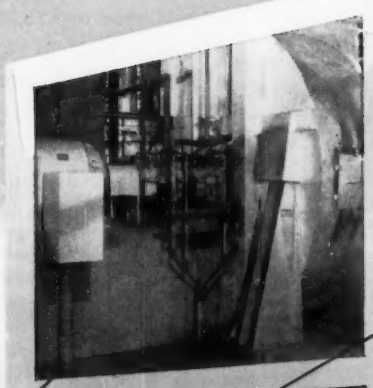
Look in the classified section of your telephone directory or write direct for the name of the A. P. Green distributor in your locality. He has complete stocks and can make prompt delivery.

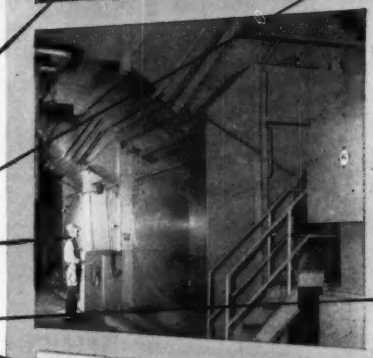
A. P. Green
REFRACTORY PRODUCTS

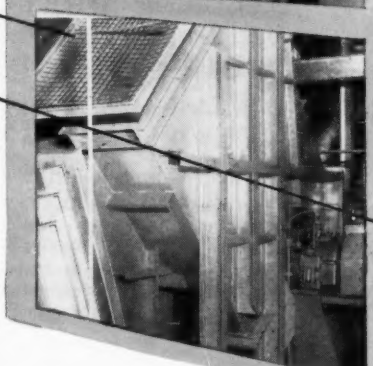
A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.

PLANTS: Mexico, Mo. • Woodbridge, N. J. • Sulphur Springs, Texas
Jackson, Oak Hill, South Webster, Ohio • Philadelphia, Pa. • Troy, Idaho
IN CANADA:
A. P. Green Fire Brick Company, Ltd., Toronto 15, Ontario

NEW AIRFOIL







Full Range Application . .

Primary Air Supply

Forced Draft:

- Balanced Draft Boilers
- Pressure Furnace Boilers
- Cyclone Furnace Boilers
  - (Standard Pressure)
  - (Super-critical Pressure)

Induced Draft:

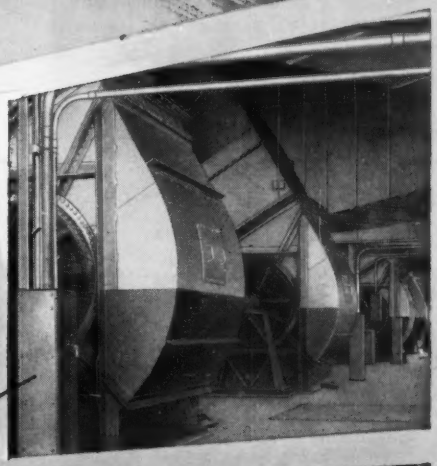
- Oil & Gas Firing
- Selected Coal Firing

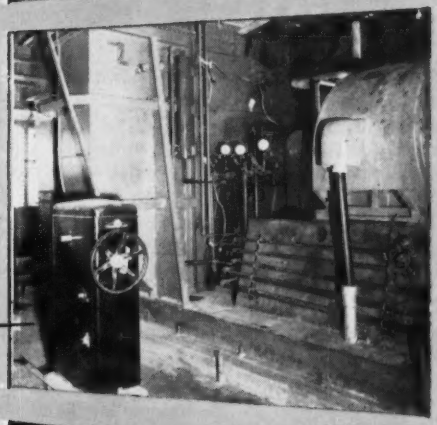
YOU CAN BE **SURE**... IF IT'S Westinghouse

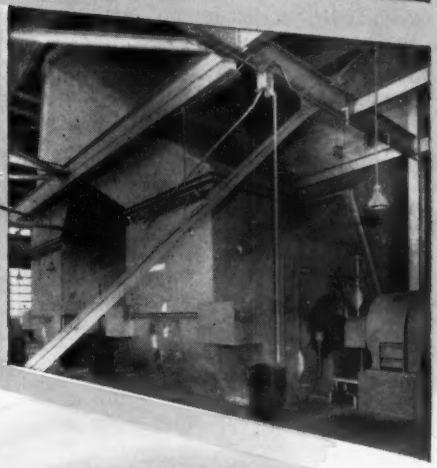
WESTINGHOUSE AIR HANDLING

MECHANICAL DRAFT FANS!

. . . the new standard in a complete line







Westinghouse now obsoletes conventional flat blading and brings you efficient and quieter Airfoil Blading for Mechanical Draft applications.

WESTINGHOUSE AIRFOIL CENTRIFUGAL FANS NOW GIVE YOU...

- ★ **LOWEST OPERATING COSTS...** High Efficiency — Low Horsepower!
- ★ **QUIET OPERATION** Airfoil Blading — Streamlined Air Flow!
- ★ **STABLE PRESSURE** Steep Curve — Ideal Parallel Operation!
- ★ **NON-OVERLOADING FEATURE** Full Load at Motor Rating — No Overload!

Now available with Airfoil Blading:

Primary Air Fans
up to 40,000 CFM ..... up to 65" pressure

Combustion Air Fans (High Pressure Forced Draft)
up to 350,000 CFM ..... up to 90" pressure

Combustion Air Fans (Standard Mechanical Draft)
up to 700,000 CFM ..... up to 40" pressure

Westinghouse Airfoil Fans now serve these leading utilities:

- Consolidated Edison
- Ohio Valley Electric Corporation
- Duke Power Company
- Delaware Power & Light Company
- Duquesne Light Company
- Indiana-Kentucky Light Company
- Pennsylvania Electric Corporation
- Southern California Edison Company
- Tennessee Valley Authority
- Philadelphia Electric Company
- Commonwealth Edison
- Dayton Power & Light
- Gulf States Utilities, Louisiana
- Cleveland Electric Illuminating Company

J-80639

More information? WRITE...

Westinghouse Electric Corporation
Sturtevant Division, Dept. K-8
Hyde Park, Boston 36, Massachusetts

Sirs:

Please send me your Catalog 1321 on Airfoil Mechanical Draft Fans!

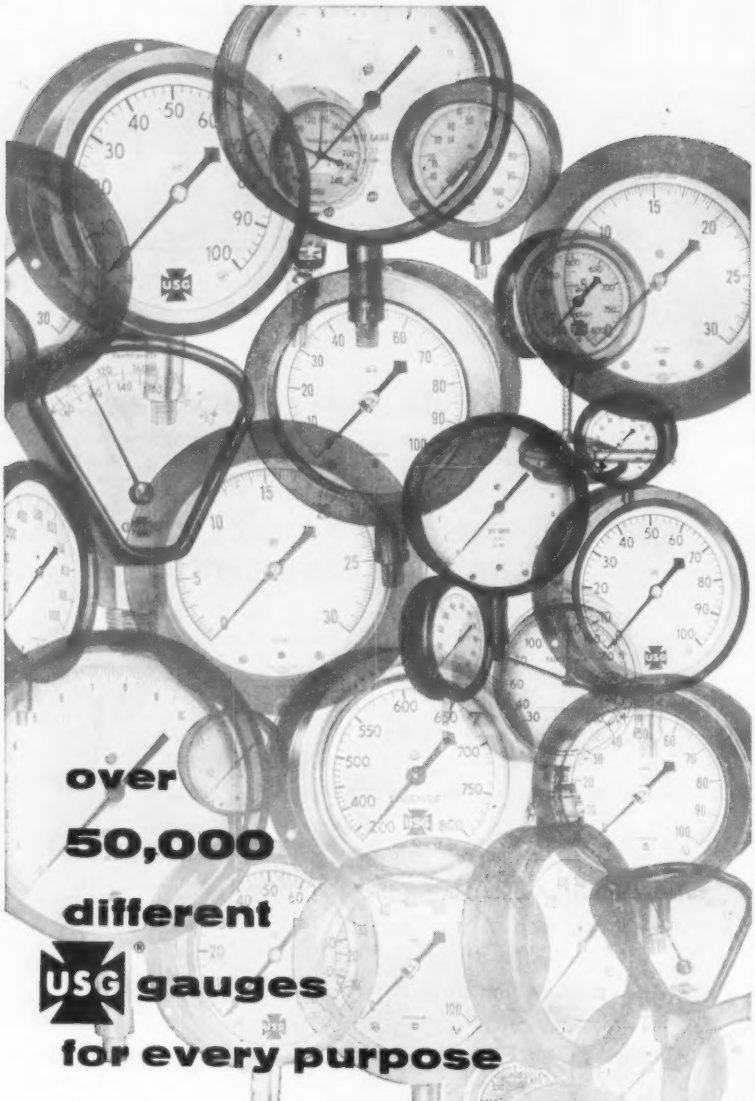
NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____



If you have requirements for pressure or temperature instruments, your best source is United States Gauge.

USG has a RUGGED, ACCURATE, DEPENDABLE gauge or instrument to fill almost every need . . . from its famous high-accuracy Test Gauges and Supergauges to low-cost steel case gauges not requiring the high accuracy or heavy duty construction of the Supergauge line.

More than 50,000 different gauges—the industry's most complete line—are readily available for applications from panelboards or individual process control to pumps, compressors, or other equipment.

Call your nearest USG Distributor today . . . see the "Yellow Pages" of your phone book or write the factory for help with your special requirements.

USG UNITED STATES GAUGE

Division of American Machine and Metals, Inc.
Sellersville, Pa.

Home of the SUPERGAUGE ®

MORE THAN 50,000 TYPES OF GAUGES • SUPERGAUGES • SOLID FRONT GAUGES • RECEIVER GAUGES • TEST GAUGES • RECORDERS • CONTROLLERS • TRANSMITTERS • PSYCHROMETERS • AVIATION INSTRUMENTS

More TECHNICAL BRIEFS

Begins on page 154

plication, it is essential that its limitations be recognized. *NFPA pamphlet No. 15.*

Proposed American Drafting Standards manual, Section 15—electrical diagrams. *By Sectional Committee Y14 on drawings and drafting practice.*

ASME announces distribution of this proposal for criticism and comment. Interested parties may obtain copies of the tentative draft without charge by addressing *Frank Philippbar, Standards Dept, ASME, 29 W 39th St, New York 18, N. Y.*

Heating and air conditioning

Analysis of an air-conditioning thermal circuit by an electronic differential analyzer. *By G V Parmelee, ASHAE Research Laboratory; P Vance, Goodyear Aircraft Corp; A N Cerny, ASHAE Research Laboratory.*

Concept of the thermal circuit is a valuable tool in the analysis of thermal systems. The thermal system can be described by a set of differential equations easily derived from the thermal circuit. However, actual solution of the equations is both laborious and tedious.

The paper describes results of the solution of thermal circuit equations as obtained by the use of an electronic differential analyzer. Independent variables, such as sol-air temperatures, were generated by electronic function generators; and dependent variables, such as heat-flow rates and surface temperatures, were plotted with conventional recording equipment.

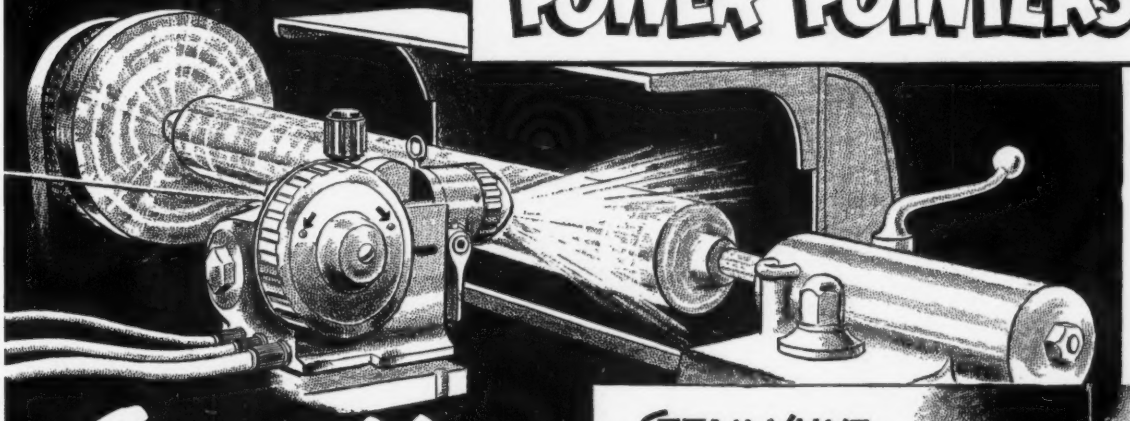
An analysis of load components resulting from a sun-exposed wall, a shaded window, and lighting in a typical office has been made. *ASHAE paper, no number.*

From '36 to '56—Air conditioning comes of age. *By W A Grant, Carrier Corp.*

The last two decades of air-conditioning progress seem strangely quiet. This has been an era of improvement, consolidation and acceptance. Industry has taken the brilliant technical and engineering advances prior to 1936, translated them into eminently marketable products and systems, produced, sold, installed and serviced them in volume. In two short decades

Directions for ordering papers on p 220

POWER POINTERS



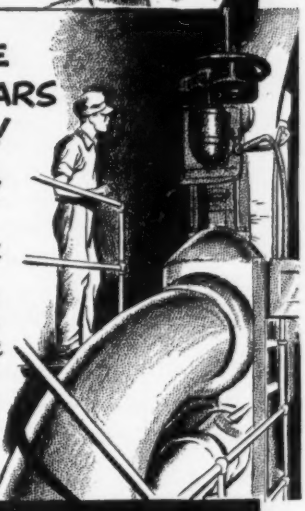
Sprays Monel

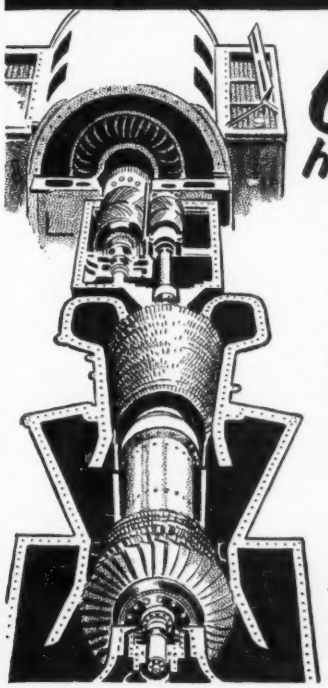
... stops rust-cutting of carbon seals

GLAND SECTIONS OF SHAFTS FOR SMALL MARINE STEAM TURBINES ARE NOW BEING SPRAYED WITH MONEL NICKEL-COPPER ALLOY FROM SPRAY GUNS THAT MELT AND BLAST DROPLETS OF METAL AGAINST THE SHAFTS. BY PREVENTING ROUGHENING OF THE SHAFT THE MONEL* ALLOY COATING HELPS MAINTAIN THE STEAM SEAL ...PREVENTS STEAM LEAKAGE AND RESULTING OIL CONTAMINATION.

STEAM VALVE SERVES 27 YEARS ...NO REPAIRS!

ITS SECRET: THE STEM, SEAT RINGS AND SEAT ARE MONEL NICKEL-COPPER ALLOY. MOTOR ACTUATED, THIS TROUBLE-FREE VALVE HAS RESISTED MORE THAN A QUARTER CENTURY OF EROSION AND CORROSION ON A MAIN STEAM HEADER OPERATED AT 350 PSI AND 700° F.

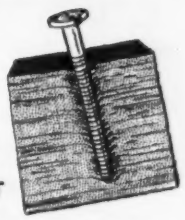




6,000 hours young

AFTER 6,000 HOURS' SERVICE, TURBINE BLADES, OPERATING AT RIFLE BULLET SPEED (1,200 FT/SEC.) AND AT RED HEAT (1,300-1,350° F. INLET TEMPERATURE) LOOKED AS THOUGH THEY HAD NOT BEEN USED AT ALL. FORGED FROM INCONEL* "X" AGE-HARDENABLE NICKEL-CHROMIUM ALLOY, THESE AND SIMILAR BLADES RESIST CREEP AND EXTREME OXIDIZING CONDITIONS MET IN INDUSTRIAL GAS TURBINES.

These nails are all "drive" and no backing out



ANNULAR GROOVES IN STRONG ANCHORFAST* MONEL NICKEL-COPPER ALLOY NAILS FORCE WOOD FIBERS TO SERVE AS WEDGES THAT LOCK INTO THE GROOVES AND PREVENT THE NAILS FROM BACKING OUT. IN COOLING TOWER SERVICE, THE GROOVES STAY SHARP AND EFFICIENT BECAUSE MONEL ALLOY RESISTS RUST AND CORROSION AND LOUVRES STAY PUT.

UP AGAINST A METAL PROBLEM?

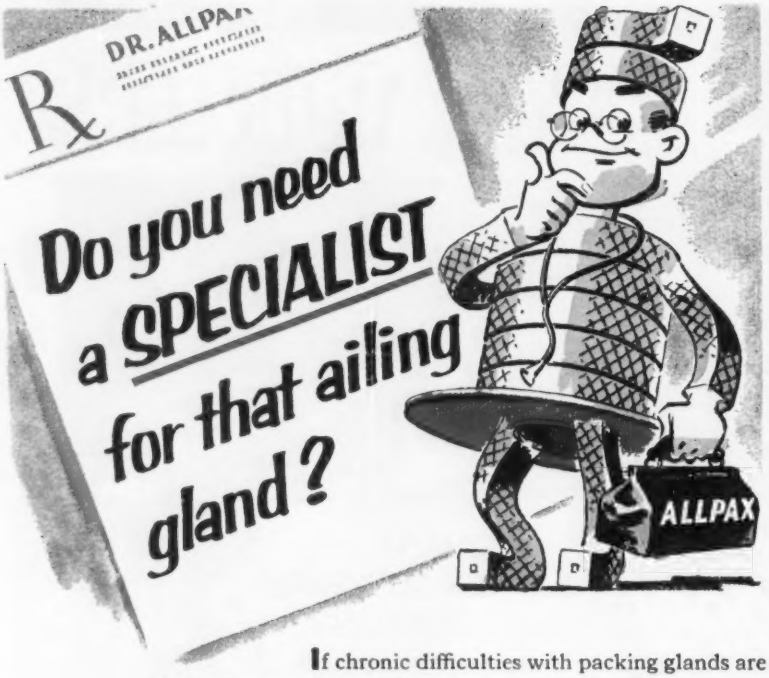
THERE'S A GOOD CHANCE THAT INCO'S MECHANICAL ENGINEERING SECTION HAS SOLVED A SIMILAR ONE OR COME CLOSE ENOUGH TO IT TO SUGGEST A GOOD ANSWER. JUST LET US KNOW THE DETAILS.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street — New York 5, N. Y.

INCO Nickel Alloys

*Registered trademark



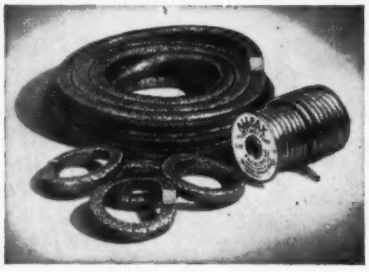
If chronic difficulties with packing glands are demanding more than their share of maintenance time, let Allpax prescribe for you. In our complete line of mechanical packings, we are sure to have the remedy you need. If your problem is a special one, Allpax will be happy to diagnose your case and design a special packing for your particular requirement.

Allpax packings cut costly downtime to a minimum, and eliminate undue wear and tear on expensive machinery. Contact your nearest distributor or write to the Allpax Applications Consultant at our factory.

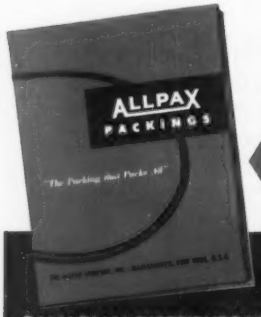
A complete selection of:

- ✔ Teflon* Packings
- ✔ High Pressure Packings
- ✔ Metallic Packings
- ✔ Plastic Packings
- ✔ Sheet Packings

*DuPont Trademark



For all your packing needs consult —



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More TECHNICAL BRIEFS

Begins on page 154

it has achieved strength and maturity.

The paper goes on to give brief descriptions of advances in air-conditioning equipment, room air conditioners, self-contained units, heat pumps, fan-coil units, residential heating, commercial and industrial heating, air cleaning, odor control, fans, air-distribution equipment, heat-exchange surface, refrigeration equipment, water-conservation equipment, automatic controls, air-conditioning systems, etc. *ASHAE paper, no number.*

The dust-spot method for evaluating air cleaners. *By K T Whitby, A B Algren, and R C Jordan, University of Minnesota.*

A study of the dust-spot method has shown that such factors as type of filter media used, optical design of the photometer and nature of the dust sampled have an important bearing on the meaning of the data obtained. For accurate work, glass fiber and millipore filters have been found superior to the chemical papers ordinarily used. An improved photometer incorporating findings of this study is also described. *ASHAE paper, no number.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

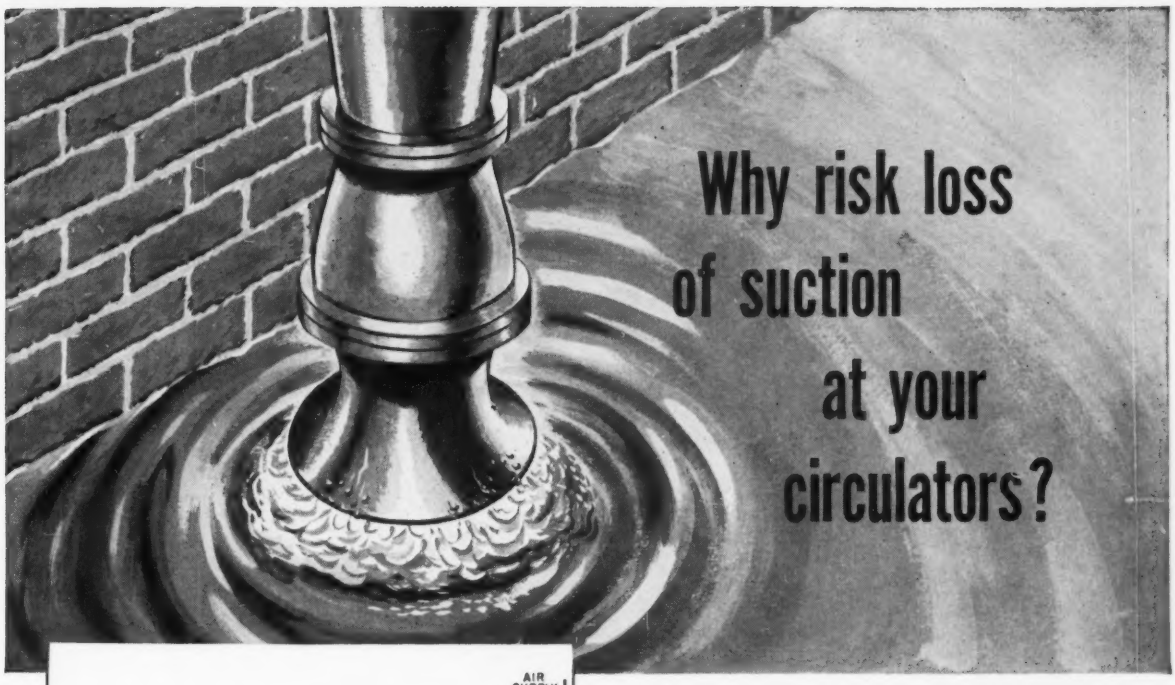
American Society of Mechanical Engineers. Identified by initials ASME and obtainable from ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable from AIEE, 33 W 39th St, New York 18, New York.

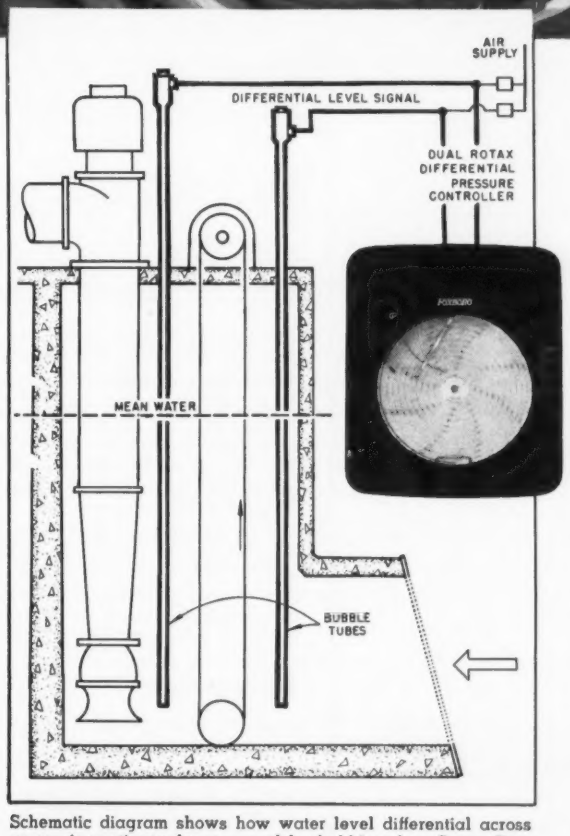
American Power Conference, 19th annual meeting. Identified by initials APC and obtainable through purchase from director, APC, Illinois Institute of Technology, Chicago 16, Illinois.

National Fire Protection Association. Identified by initials NFPA and obtainable through purchase from NFPA, 60 Batterymarch St, Boston 10, Mass.

American Society of Heating and Air Conditioning Engineers. Identified by initials ASHAE and obtainable from ASHAE, 62 Worth St, New York, N. Y.



Why risk loss of suction at your circulators?



Schematic diagram shows how water level differential across screen is continuously measured by bubble tubes. Rotax Controller starts and stops screen and spray motors as required.

. . . let Foxboro Control keep traveling screens clean — *automatically*

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This completely adjustable Foxboro System automatically starts the screen motor and cleansing spray whenever accumulated refuse causes water level on opposite sides of the screen to differ more than a desired, pre-set amount. And, in addition to purging the screen and restoring proper intake level, this versatile system can carry out any or all of the following "positive protection" functions — depending on plant requirements: 1. Annunciate "high" differential water level at adjustable set-points. 2. Prevent start of screen until sprays are on — to avoid carry-over. 3. Shut down screen motor and spray pump (a) when proper level is restored — or (b) when screen has made one complete rotation. 4. Indicate or record differential level in ranges from 0-5" water to 0-50" water. 5. Annunciate loss of purging air supply. 6. Provide centralization of *all* screen house functions.

Let this modern system protect your plant against costly shut-downs. It's easily installed, inexpensive to operate, thoroughly dependable. For full details, contact your nearby Foxboro Field Engineer, or write **The Foxboro Company, 6810 Neponset Ave., Foxboro, Mass.**

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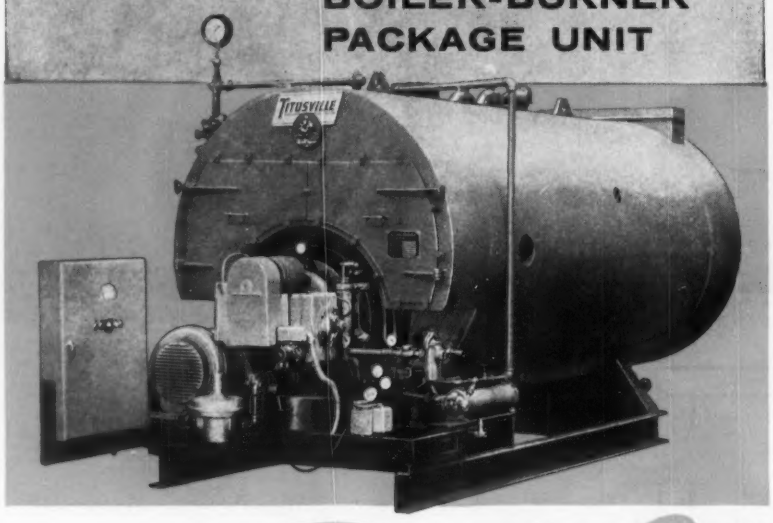

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APPOINTMENTS

Corporation executive changes

Rockwell Manufacturing Co: Munro Corbin, vice-president. **Consolidated Edison Co of New York:** Otto W Manz Jr, executive vice-president. **Yarnall-Waring Co:** Bernard G Waring, honorary chairman; D Robert Yarnall, chairman; Frank W. Miller, president. **McQuay Inc:** Byron E James, president; Jay R Resch, vice-president; Kenneth R Lundberg, vice-president. **Texas Gas Transmission Corp:** F K Rader, vice-president.

Detroit Stoker Co: Heinz Pagels, vice-president and general manager; Eugene H Glaettli, secretary and treasurer. **Insulmatic Inc:** Norman T Shideler, president. **Hercules Motors Corp:** William L Pringle, president; Henry H Timken Jr, chairman. **Ray-O-Vac Co:** Elmer B Ott, president. **General Precision Laboratory:** Dr Raymond L Garman, chairman; James W Murray, president.

Cooper-Bessemer Corp: Robert F Lay, vice-president. **National Forge & Ordnance Co:** John C Harrington, chairman; Robert O Wilder, president; Duane E Wilder, vice-president. **Coppus Engineering Corp:** Jerome R George Jr, chairman; Raymond J Forkey, president. **American Brake Shoe Co,** National Bearing Div: Albert L Hunt and Paul J Bauman, vice-presidents.

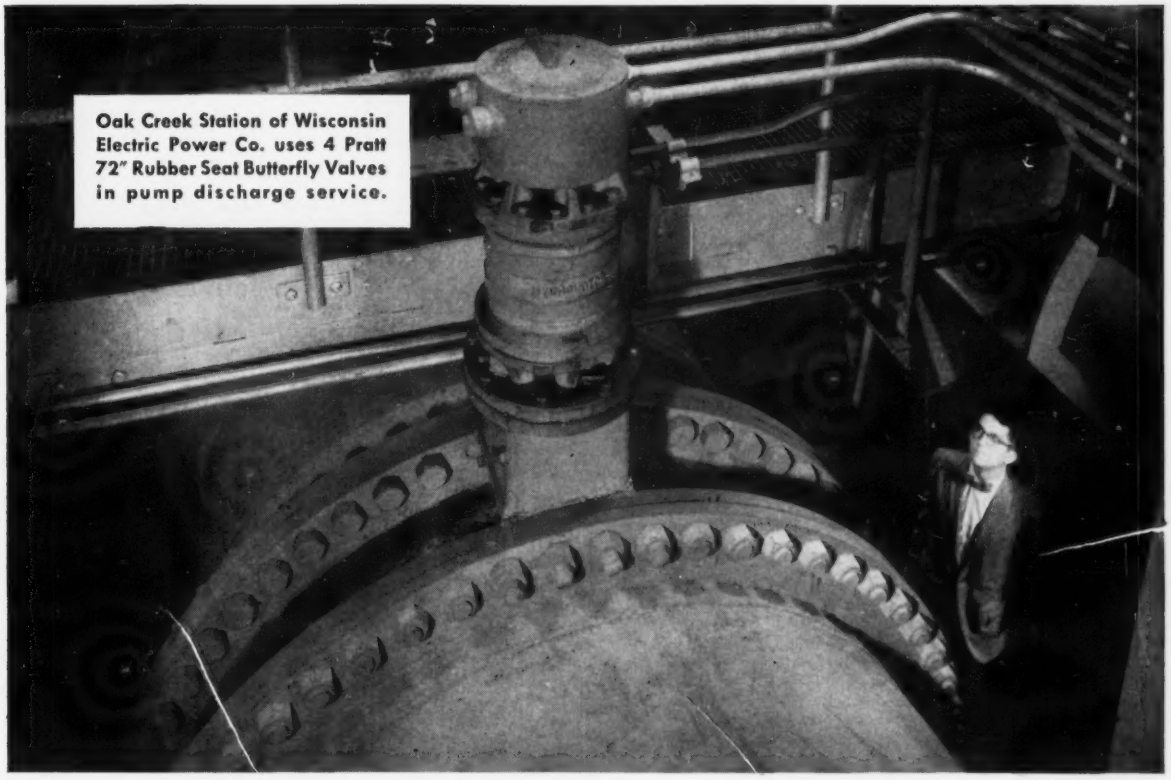
Operations executive changes

Pittsburgh Coke & Chemical Co, Protective Coatings Div: Arthur E Gray, general manager. **Minneapolis-Honeywell Regulator Co,** Fall River plant: George W Hoffmeister, general superintendent. **H K Porter Co,** Delta-Star Electric Div, Thomas Works: Frank Mason, manager. **Reliance Electric & Engineering Co:** Robert O Gee, manager of application engineering; George E Law, manager of service; William C McConnell, manager of general products. **Blaw-Knox Co,** Power Piping & Sprinkler Div: Robert E Davies, production manager.

Engineer changes

C&D Batteries: Dr Eugene Willihnganz, director of research. **Lear, Inc,** LearCal Div: Kenneth M Miller, manager of engineering. **Brush Electronics Co:** Ralph V Little Jr, manager of product engineering. **Kennedy Valve Mfg Co:** James W Dashner, chief engineer. **H K Porter Co,** Delta-Star Electric Div, Thomas Works; Walter Taylor, ceramic engineer. **U.S. Rubber Co:** William R Tise, Western belting engineer. **Hammond Iron Works:** A F Fino, chief engineer.

Perkin Engineering Corp: Fred Lilienstein, engineering supervisor; Richard A Rall, chief of heavy duty



Oak Creek Station of Wisconsin Electric Power Co. uses 4 Pratt 72" Rubber Seat Butterfly Valves in pump discharge service.

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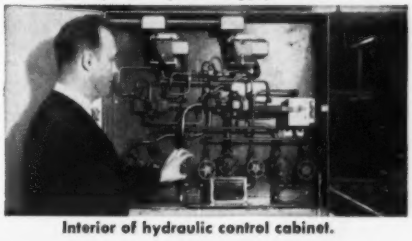
Felix Kazmerchak, Ass't. Plant Engineer, and Ray F. Egebrecht, Pratt Representative, inspect hydraulic power supply.



Interior of hydraulic control cabinet.

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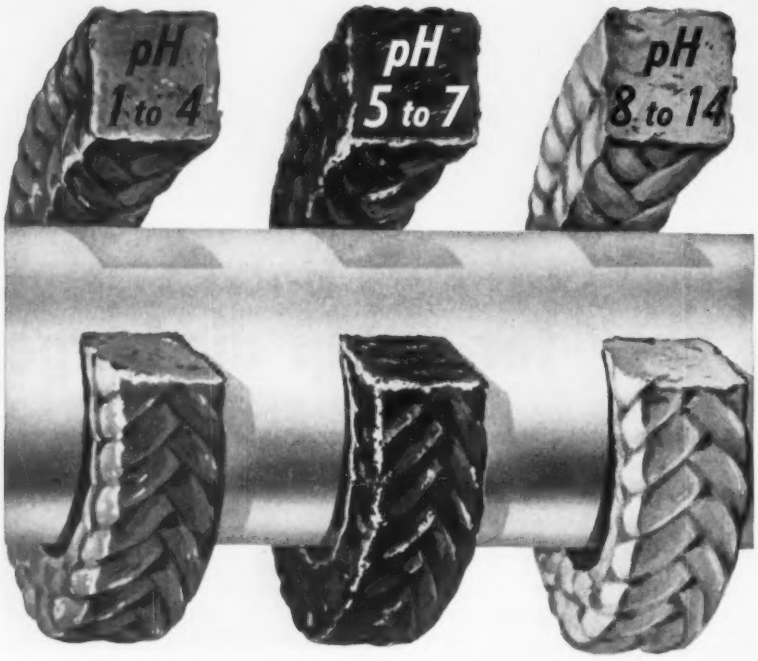

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More APPOINTMENTS

Begins on page 222

rectifier div. **Frank G Hough Co:** Jules C Laegeler, chief engineer. **Chemtrol Corp:** Don Jenson, chief engineer. **Consolidated Electrodynamics Corp,** Alectra Div: Willard T Holmes, director of engineering. **B F Goodrich Tire Co,** Akron plant: Joseph B Koesterer, manager of engineering. **Copeland Refrigeration Corp:** Donald E Fry, chief engineer.

Westinghouse Electric Corp, Meter Div: William K Sonnemann, relay consulting engineer; William E Glassburn, relay engineering manager. **Dodge Manufacturing Corp:** Paul Jordan, director of engineering. **Sweet Manufacturing Co:** E A N Hallstrom, chief engineer, industrial div; W H Paul, project engineer. **Brush Electronics Co:** Reginald G Schuler, general engineering manager. **A O Smith Corp,** Welding Products Div: R J Keller, chief engineer. **Bechtel Corp:** Stanley A Ward, executive engineer.

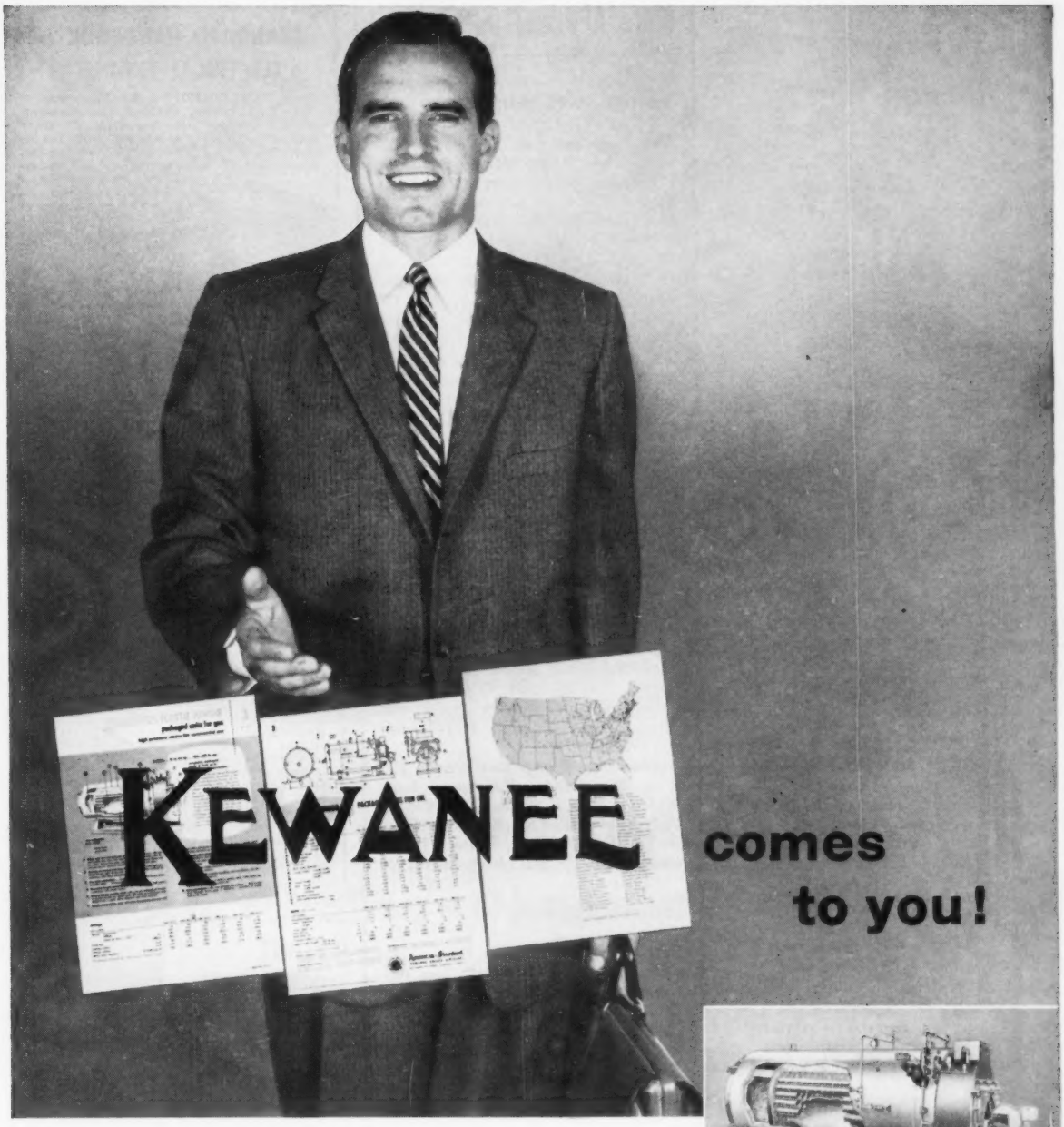
Brooks Rotameter Co: George D Keller, chief engineer. **Allis-Chalmers Manufacturing Co:** John T Carroll, assistant engineer in control dept; John C Schildwachter, application engineer in compressor dept; Terre Haute Works: Harold G Zambell, engineer in charge of tests and developments. **National Valve & Manufacturing Co:** R W Fink, chief engineer. **Burns & Roe Inc:** Thomas Y Mullen, chief power projects engineer; Martin A Mayers, chief special projects.

General sales managers

Cooper-Bessemer Corp: Grant C Woodard. **Federal Pacific Electric Co:** Robert L Bobo. **Fischer & Porter Co:** Robert L Rice. **Cornell-Dubilier Electric Corp:** Robert Arany, power factor capacitor div. **Food Machinery & Chemical Corp,** Peerless Pump Div: Everett W Lundy. **L A Young Spring & Wire Corp,** Ottawa Steel Div: Ivan K Knight, **James G Biddle Co:** Philip E Sellers.

Gould-National Batteries Inc, Industrial Div: John P Kelly. **Consolidated Avionics Corp:** Peter J Reuter. **Calumet & Hecla Inc,** Forest Industries Div: G A Houghton Jr. **Alco Products Inc:** John M Howard Jr, general manager, spring and forge div; Marshall D Raymond, marketing manager. **American Brake Shoe Co,** AmForge Div: Francis W Holbrook, marketing manager; George L Essig, sales manager. **Femco Inc:** John W Bauer. **Detroit Stoker Co:** Ralph C Davis. **Westinghouse Electric Corp:** Victor J Kropf, atomic fuel dept. **Wayne Pump Co:** Ralph G Pappert, manager of sales service, industrial div. **De Laval Steam Turbine Co:** Michael Toth, turbocharger sales. **Babcock & Wilcox Co,** Tubular Products Div; James J Barrett, extrusion sales.

(*Continued on page* 226)



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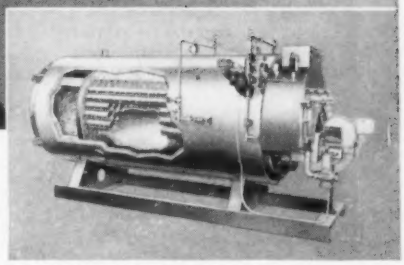

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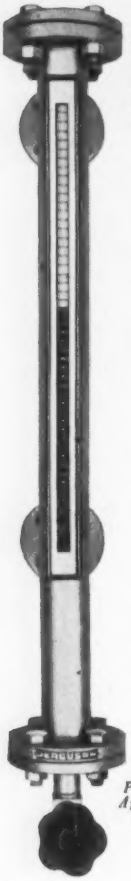

An important advancement in liquid level observation for plants with dangerous explosive or inflammable conditions.

Safety design seals against escaping gases.

Measuring mechanism in stainless steel chamber.

Scale mounted outside chamber; magnetically actuated through chamber wall.

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More APPOINTMENTS

Begins on page 222

District sales managers

The Swartout Co: Stephen K Wilmot, Tulsa. **Bailey Meter Co:** K T Bridgman, Schenectady. **Detroit Stoker Co:** N H Johnson, Minneapolis. **Leslie Co:** Roy D Kelley, Southeastern district. **Graybar Electric Co:** Creighton C Kohnert, Gulf Coast; K D Leavitt, Cleveland. **Worthington Corp,** Mason-Neilan Div: John W Brown, Pittsburgh; Thomas S Robinson, Seattle; A S Chatfield, Wilmington. **Carrier Corp,** Machinery & Systems Div: John F Kooistra, Western regional manager.

Garlock Packing Co: Charles F Palmer Jr, Chicago; Phil D Yates, Pittsburgh; Eugene G Flannery, Philadelphia. **Minnesota Rubber & Gasket Co:** Howard E Anderson Jr, Cleveland. **Elliott Co:** H J Campbell, Kansas City. **Kennedy Valve Manufacturing Co:** Gene Reinersman, Kentucky; W F Strickland, Decatur; A E Hockaday, Dallas; Edward Shortall, San Francisco. **Trane Co:** Joseph Rohats, Phoenix; Robert Knowles, Greenville; Robert W Thomas, New York. **Nordberg Manufacturing Co,** Engine Div: Richard C Gamble, St Louis. **Alco Products:** Robert W Pittman, central region; E J Brown, San Francisco.

Blackmer Pump Co: Warren DeWitt, Ohio Valley. **Hammond Iron Works:** Max G Walker, Pittsburgh. **Federal Pacific Electric Co:** B S Burke, Great Lakes. **Tube Turns Plastics Inc:** S McCulloch, northeast.

Institute Elections

National Assn of Power Engineers: J Dudley Holmes, president. **The Refractories Institute:** J E Brinckerhoff, president. **American Society for Engineering Education:** Dr Frederick C Lindvall, president.

Obituaries

F Ray Peterson, 55, assistant to the president of R G LeTourneau, Inc, on July 29.

Irving W Reynolds, 77, vice-president of The Foxboro Company, on June 3.

Paul T Owens, 57, Milwaukee district lighting sales manager for Sylvania Electric Products Inc, on June 26.

Harold S Metcalfe, 69, retired public-relations director, West Penn Power Co, on June 16.

Edward H Wannemacher, former sales vice-president, James G Biddle Co, on July 3.

Walter C Kerrigan, assistant to the president of The International Nickel Co, on July 16.

John R McConnell, 69, former vice-president and advertising director, American Air Filter Co, on August 8.

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To meet the power demands of increased cigarette production, The R. J. Reynolds Tobacco Company of Winston-Salem, North Carolina, recently installed the two Okolite-Okoprene aerial cables shown here. An operating voltage of 15kv and a span of 420 feet across two open primary lines and railroad sidings called for aerial cables with maximum reliability. Okolite-Okoprene self-supporting cable was used, with extra messenger for added safety.

Here is another case where an Okonite self-supporting aerial cable solved an increased power-demand problem simply and economically. The overhead route often costs much less than the underground route . . . and it can be just as safe, too, when you use dependable Okolite-Okoprene cable. Recommended for general use up to 35kv, Okolite-Okoprene is insulated by Okonite's exclusive strip process and (if rated at over 2kv) inspected inch-by-inch on the Gooding Test Train.

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Cuts the cost of steam

REPORTS from the FIELD

Begins on page 152

Arc-image furnace *continued*

rain or shine.

Previous furnaces used specially designed parabolic mirrors to focus the arc's energy onto the substance to be heated. New design uses elliptical mirrors of standard type found in motion picture equipment. One mirror directs arc energy at the other, which in turn concentrates radiation on specimen to be heated, forming a life-size image of the actual arc.

The equipment, developed by National Carbon Co, a division of Union Carbide Corp, uses 18-in. mirrors to produce temperatures comparable to a 60-in. solar furnace. Arc uses 200 amp, 80 volts.

The furnace is now designed for ½-in. carbons, but can be extended to larger arcs and high power. One restriction: Only materials which absorb energy can be heated. Shiny objects would reflect rays, remain cool.

Yugoslavia lays plans for site of co-op power plant

GENEVA, MCGRAW-HILL WORLD NEWS —In its recent meeting held at Llublijana, Yugoslavia, the Inter-European study syndicate of Yugelexport decided that the first power plant to be erected under the scheme will be the Lika-Gacka plant, a 294 mw installed-capacity plant with an average yearly output of one billion kwh.

Construction of the plant will take about five years and cost about 42 million dollars.

Two years ago the Yugelexport scheme sprang out of the fact that, alone among European countries, Yugoslavia still has large unused water power resources while neighbors such as Bavaria and Italy have already practically reached the limit of their development in this field. A plan was, therefore, evolved which provides for the joint setting up of hydro-electric power plants in Yugoslav territory, the production of which would go to the neighboring countries. Rules provide that any other interested country can join the scheme.

Combining a known electrical principle with standard recording instruments, General Electric's Instrument Dept engineers have developed a new method to measure generator field temperature. New method combines a Kelvin double bridge circuit with an indicating recorder to relate conductor resistance changes to temperature of generator field windings.

(**Continued on page 230**)

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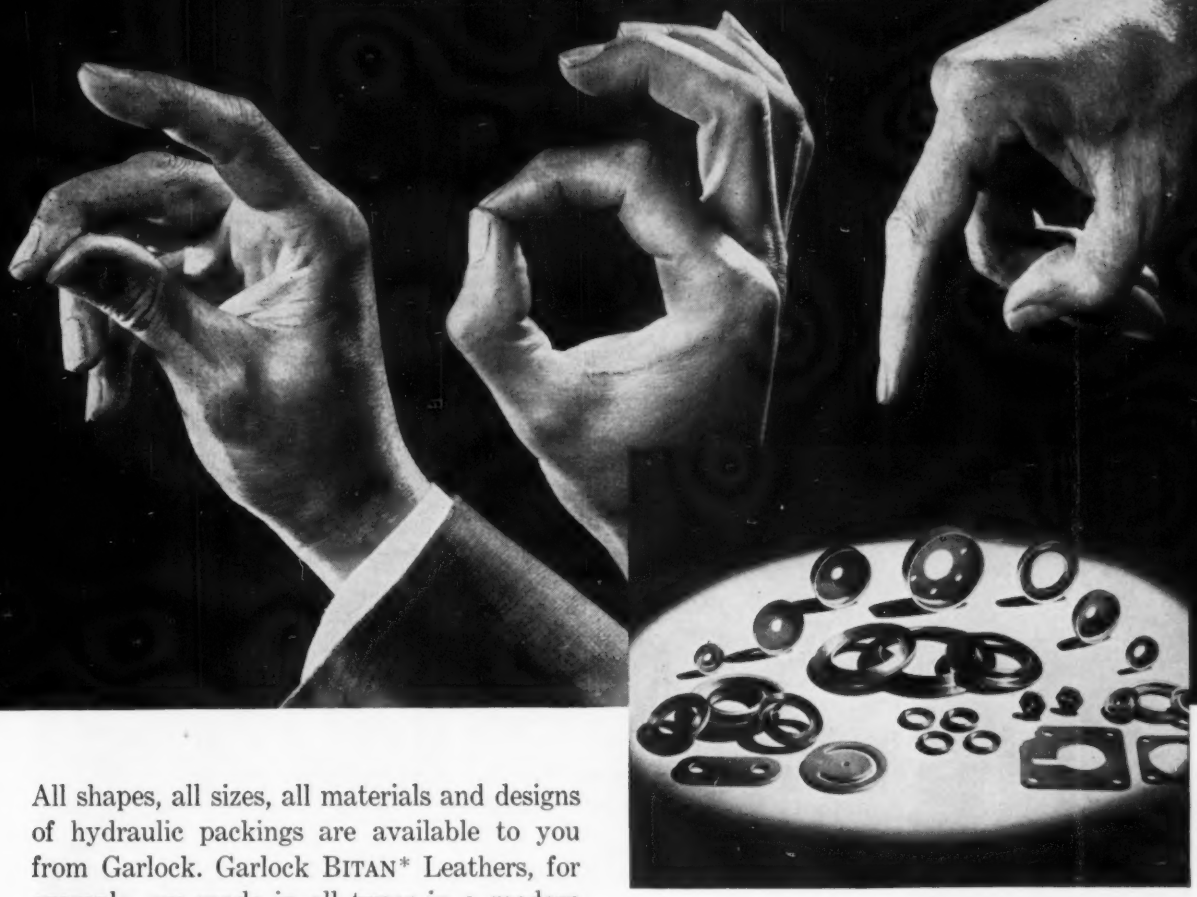


All shapes, all sizes, all materials and designs of hydraulic packings are available to you from Garlock. Garlock BITAN* Leathers, for example, are made in all types in a modern leather packing plant which maintains highest standards of quality. Molded Cups, "U" Packings, "V" Packings, Washers, Gaskets, Discs, Flange or Hat Packings are some of the more commonly specified types. Sizes range from 1/8" O.D. leather washers for needle valves to 99" O.D. "U" Packings for heavy duty hydraulic service.

Let us know your requirements. Your Garlock representative will recommend from "the famous Garlock 2,000" . . . two thousand styles of packings, gaskets, and seals for every need. The only *complete* line. Call today or write for leather packing Folder AD-121.

*Registered Trademark

THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products

D.T. Williams and DETROIT CONTROLS

the names are good

Reputation is a matter of record. And the record of D. T. Williams for dependability and performance has been firmly established over the years.

Now, as a part of Detroit Controls, the high quality is being maintained, so that you may continue to place your confidence in this product, assured of ready supply and good service.

because the products are right

No. 856 "Vulcodisc" Lift Check Valve

Vulcanized asbestos disc. For 200 lbs. working steam pressure at 500° F. or 400 lbs. working non-shock gas and liquid pressure at 150° F. Installed in horizontal position. Screw cap and screw ends.

No. 1086 Swing Check Valve

Vulcanized asbestos disc. For 200 lbs. working steam pressure at 500° F. or 400 lbs. working non-shock gas and liquid pressure at 150° F. Installed in horizontal or vertical position. Screw cap and screw ends.

No. 912 "Vulcodisc" Globe Valve

May be used for steam or hot water with pressures to 200 lbs., temperatures to 500° F.; or water, gas and air to 400 lbs. at 150° F.; for oil to 200 lbs. pressure at 250° F.

No. 833 Horizontal Check Valve

Renewable composition, air disc, integral seat, screw ends, spring loaded disc. 300 lbs. working non-shock gas and liquid pressure at 150° F.

These valves meet all government, marine and industrial specifications.

Quality Protects Your Investment--

AMERICAN-Standard Quality Is Available At No Extra Cost.

Bridgeport 1, Connecticut

DETROIT CONTROLS

Division of AMERICAN-Standard

REPORTS from the FIELD

Begins on page 152

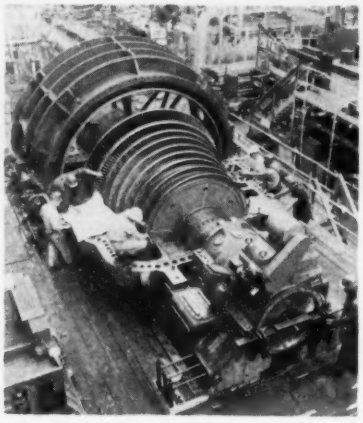
Power issues directory of manufacturers' agents for '58

The 1957-1958 "Directory of Manufacturers' Agents Serving the Power Field" is said to be the largest such directory put out by POWER. It is also thought to be the only publication of its kind in the field.

It contains information on more than 2500 agents in every state of the U.S., and in most other countries of the world, including Canada, Mexico, France, Great Britain, Spain, Turkey, Germany and others.

Agents are listed alphabetically by state, city and company; each item specifies firm members, salesmen, branch offices, territory covered, power field manufacturers represented and products handled, where this information was supplied by the agent.

Directories are priced at $15.00 a copy.



Steam turbine-generator exhausts along turbine axis

► A STEAM TURBINE-GENERATOR unit which embodies an important improvement in the turbine design is being manufactured in Schenectady for South Carolina Gas and Electric Co by the General Electric Co's Large Steam Turbine-Generator Dept.

Unit exhausts its steam horizontally along the axis of the turbine shaft into the condenser which is attached to the exhaust end of the turbine. The usual turbine arrangement has the condenser located directly below the exhaust end of the turbines.

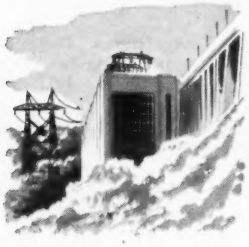
GE describes the new feature as "axial flow exhaust," and cites two important advantages. First, it is said to improve the efficiency of the turbine which means that it will require less

The world of science behind
EXIDE-MANCHEX BATTERIES

Being interviewed is J. P. Malloy, Chief Control Engineer. Shown at lower left is a positive plate from an Exide-Manchex Battery.

"High purity lead prolongs battery dependability"

At the Exide Laboratories—**Reporter:** Just exactly how pure is the lead in Exide-Manchex positive plate buttons, Mr. Malloy?



Malloy: There is less than one-hundredth of 1% active impurity.

Reporter: How do you insure and maintain such a high degree of purity?

Malloy: We test every new batch of lead here in our laboratory before we approve it for use.

Reporter: How does this high purity lead extend battery dependability?

Malloy: It converts to active material at the proper rate. Over years of use, these Exide-Manchex Batteries retain their capacity to provide full power when needed.

Reporter: Obviously, this is an important feature of Exide-Manchex Batteries.

Malloy: Yes it is. But it's only one of the many engineering details that contribute to their long life and high performance.

Note to battery users: Whenever you order batteries for float or cycle service in stationary applications, be sure to specify Exide-Manchex. Write for detailed bulletin. Exide Industrial Division, The Electric Storage Battery Company, Phila. 2, Pa.

THE ELECTRIC STORAGE BATTERY COMPANY **Exide**®

SWECO introduces a complete new line of steam jet ejectors, available in single and multiple stages and in a wide range of sizes and materials. Entirely new designs incorporate the most recent developments in the field—to meet the vacuum requirements of the power and process industries flexibly and efficiently.

Ejectors, the most widely used vacuum-producing devices, are particularly applicable where condensable vapors or corrosive substances must be condensed. SWECO's improved construction utilizes corrosion-resistant materials to protect the unit while in operation and to minimize rusting during shut-down. The units are generously designed, easy to service, with ample test connections for quick performance checks in the field.

SWECO Steam Jet Ejectors are available from 1" to 8" and larger, and from 1 to 6 stages. For extra flexibility, any number of units may be used in parallel. Various combinations of inter-condensers and after-condensers can be provided for individual requirements.

A new 8-page bulletin describes and illustrates design, construction, sizes, combinations and uses of SWECO Steam Jet Ejectors. It also includes a set of valuable Dalton's Law charts with instructions to determine the relationship between percent air in various air-water vapor mixtures vs temperature of the mixtures for various pressures. Write for your copy. It's Bulletin M-4-393.

See SWECO *equipment at the 26th Exposition of Chemical Industries, New York Coliseum, December 2-6, Booth 1307.*

SWECO

Southwestern Engineering Company
4800 Santa Fe Avenue, Los Angeles 58, California
LUdlow 3-6262 - Cable: SWECOLA

ENGINEERS AND CONSTRUCTORS...MANUFACTURERS

REPORTS from the FIELD

Begins on page 152

fuel, coal or gas, to operate. This, say GE-men, could amount to a coal saving of 2000 tons in a year's operation. The second advantage is a saving in the cost of station itself. Because condenser is located at same level as the turbine, instead of beneath it, the turbine foundation and the turbine room structure can be lower, resulting in lower construction costs.

This is first of two such units to be installed in a new steam power station located on Lake Murray, and adjacent to company's Saluda Dam hydroelectric station.

Cooling water necessary to condense steam from the turbine will come from the penstocks of the hydroelectric station, which takes water from the depths of Lake Murray above the dam. This water from the lake's bottom is cold the year round, seldom going above 55 F during the entire year. This cold water makes it possible to obtain the maximum amount of power from the steam going through the turbine.

The turbine is described as a cross-compound single-flow reheat type with axial-flow exhaust. Steam from the boilers will enter the turbine at 2400 psig and 1050 F. The high pressure element of the turbine revolves at 3600 rpm, and the low pressure element at 1800 amp.

Delivery of the powermaker is scheduled to be made late this year.

Calendar of Events

Oct 14-18 — International Industrial Development Conference, co-sponsors: Time-Life International and Stanford Research Institute. Fairmont Hotel, San Francisco, Calif. Details from Stanford Research Institute, Menlo Park, Calif.

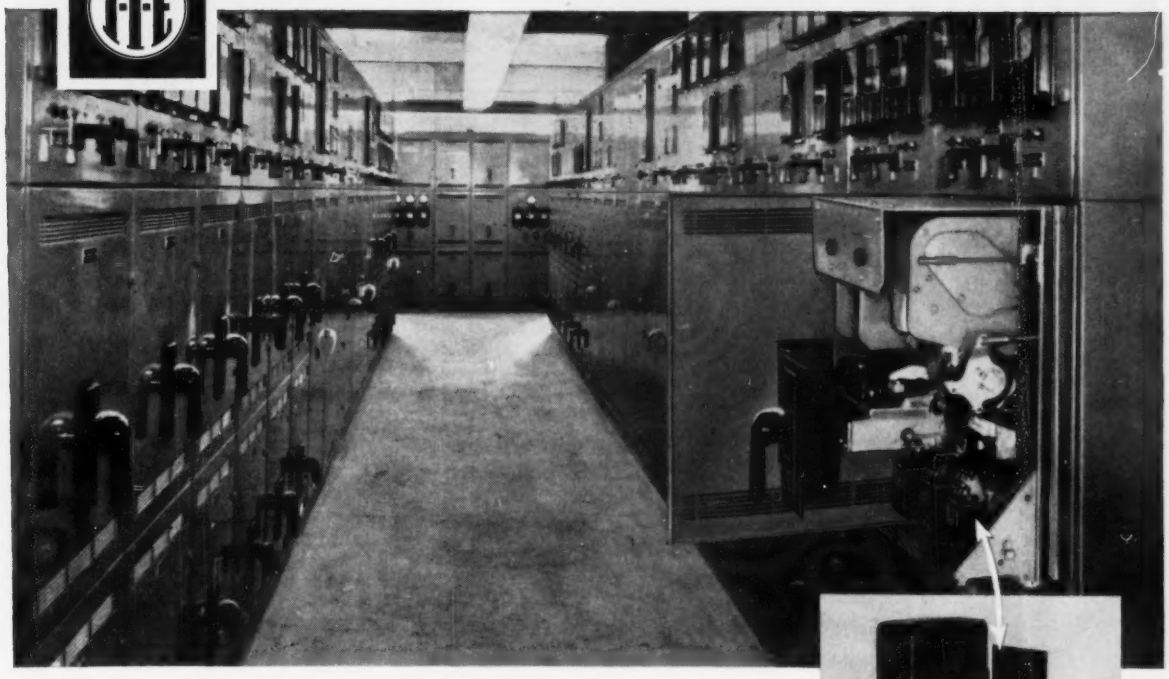
Oct 14-18—American Society of Civil Engineers, annual meeting. Hotel Statler, New York City. Details from ASCE, 33 W 39th St, New York 18, N. Y.

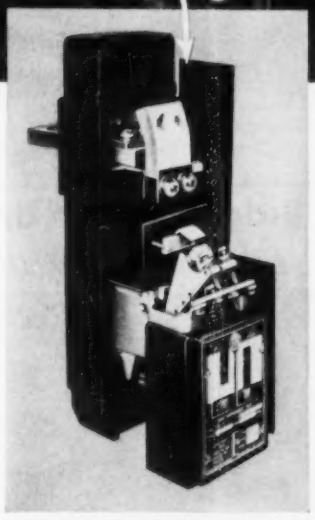
Oct 14-18 — Plant Layout Technical Workshop, fifth semi-annual session. Greater Pittsburgh Airport Hotel. Details from Homer H Dasey, Plant Layout Technical Workshop, Box 233, Oakmont (Allegheny County), Pa.

Oct 15-16—Corrosion Convention and Exhibition. Sponsored by *Corrosion Technology* magazine. Central Hall, Westminster, London, England. Details from *Corrosion Technology*, Stratford House, Eden St, London N.W. 1, England.

Oct 15-18—American Institute of Mining, Metallurgical and Petroleum En-

LOW VOLTAGE SWITCHGEAR





Here's SENSITIVE Circuit Protection

Some temporary overcurrents are tolerable; should even be permitted to occur. But sensitive circuit protection is needed to interrupt them when they persist too long or are of too high a magnitude.

The I-T-E Type OD-1 dual magnetic overcurrent trip device gives such protection. It permits temporary overcurrents, but limits them in duration and magnitude. This device will trip the circuit breaker after a predetermined interval on relatively low overcurrents or will trip instantaneously on high-magnitude fault currents. In either case you get safe, positive protection—sensitive to the needs of the circuit and the equipment on it.

For complete information on sensitive circuit protection, including selective tripping, undervoltage and other tripping devices, contact your local I-T-E sales representative. Or write for Bulletin 6004B. I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

Features of the I-T-E Type OD-1 Trip Device

PRECISION BUILT and factory calibrated to provide the highest possible accuracy in operation.

SEALED SILICONE TIMING ELEMENT. No maintenance. No oil to handle, no level to maintain, no sludging.

QUIET. Resonant vibration dampeners prevent a-c noise and wear on parts.

COMPLETELY ADJUSTABLE IN SERVICE. The delay pickup is easily adjusted from 80 to 160% of the continuous current rating. The instantaneous pickup is adjustable from 500 to 1500% of the continuous current rating. The time delay is adjustable to any of three time delay bands—minimum, intermediate and maximum.

SAFE DEAD FRONT DESIGN. Insulated knobs permit safe adjustment on a *hot* circuit breaker.

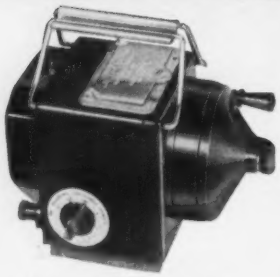
DEPENDABLE impact tripping action. The *hammer blow* movement of the time delay armature at end of timing stroke gives positive operation.

FAST RESETTING. Sensitive check valve on the piston provides quick resetting of the time delay. Repeat tripping is assured.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

IN CANADA: EASTERN POWER DEVICES, LTD.

BIDDLE *Instrument News*



Meg® Type
of Megger
INSULATION TESTER

With NEW A-R-K Switch Gives You ALL THESE FEATURES IN ONE INSTRUMENT

- Megohm Scale ÷ 1 and ÷ 10 (Formerly the A switch)
- Ohm Scale (Formerly the R switch)
- Capacitance Discharge (Formerly the K switch)
- Earth, Line and Guard terminals—no need to change terminal connections when switching to ohm scale

This multi-purpose switch affords you all these features in one instrument. Available with voltages of 500 or 1000 volts d-c and with ranges from 0 to 20 up to 0 to 2000 megohms—0 to 10,000 ohms.

For prices and specifications write for **BULLETIN 21-45-P**

Biddle Motor and Phase Rotation Tester (*Dual Purpose*)

With it you can...

Determine the direction of rotation of electric motors before they are connected to the line.

Determine the phase rotation or sequence of energized power circuits.

Here is a positive means for determining which motor leads must be connected to certain conductors of a supply system to insure that the motor will rotate in a prescribed direction when energized.

This device will permit the electrical contractor or industrial maintenance electrician to permanently connect and tape the terminals of the motor being installed, without having to first energize the motor by a temporary "hook-up" from a power source, if available, to determine its rotation.

Housed in a sturdy oak case 12¼" x 8¼" x 4¼" this compact unit weighs approximately 10 pounds and is supplied complete with 3 line and 3 motor leads which store in the compartments either side of the instrument panel.

For complete details write for **BULLETIN 80-P**

B-713

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

REPORTS from the FIELD

Begins on page 152

gineers, first annual meeting of Society of Mining Engineers. Hillsboro and Tampa Terrace Hotels, Tampa, Fla. Details from AIMMPE, 29 W 39th St, New York 18, N. Y.

Oct 16-18—American Society for Quality Control, 11th annual New England Quality Control Conference. Stratfield Hotel, Bridgeport, Conn. Details from Howard Levenson, Omaton Div, Burndy Corp, Norwalk, Conn.

Oct 16-18—American Institute of Electrical Engineers, conference on Computers in Control. Chalfonte-Haddon Hotel, Atlantic City, N. J. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Oct 17-18—National Conference on Industrial Hydraulics, co-sponsors: Illinois Institute of Technology and Armour Research Foundation. Hotel Sherman, Chicago. Details from Illinois Institute of Technology, 35 W 33rd St, Technology Center, Chicago, Ill.

Oct 21-23—American Society of Mechanical Engineers, conference on new developments in the field of power. Americus Hotel, Allentown, Pa. Details from ASME, 29 W 39th St, New York 18, N. Y.

Oct 22-24 — National Association of Corrosion Engineers, 7th Annual Western Regional Conference, San Diego, Calif. Details: NACE, 1061 M&M Bldg, Houston, Texas.

Oct 24-25—Engineer's Joint Council and Engineer's Council for Professional Development, Engineers' General Assembly. Statler Hotel, New York. Details from Engineers' Joint Council, 29 W 39th St, New York 18, N. Y.

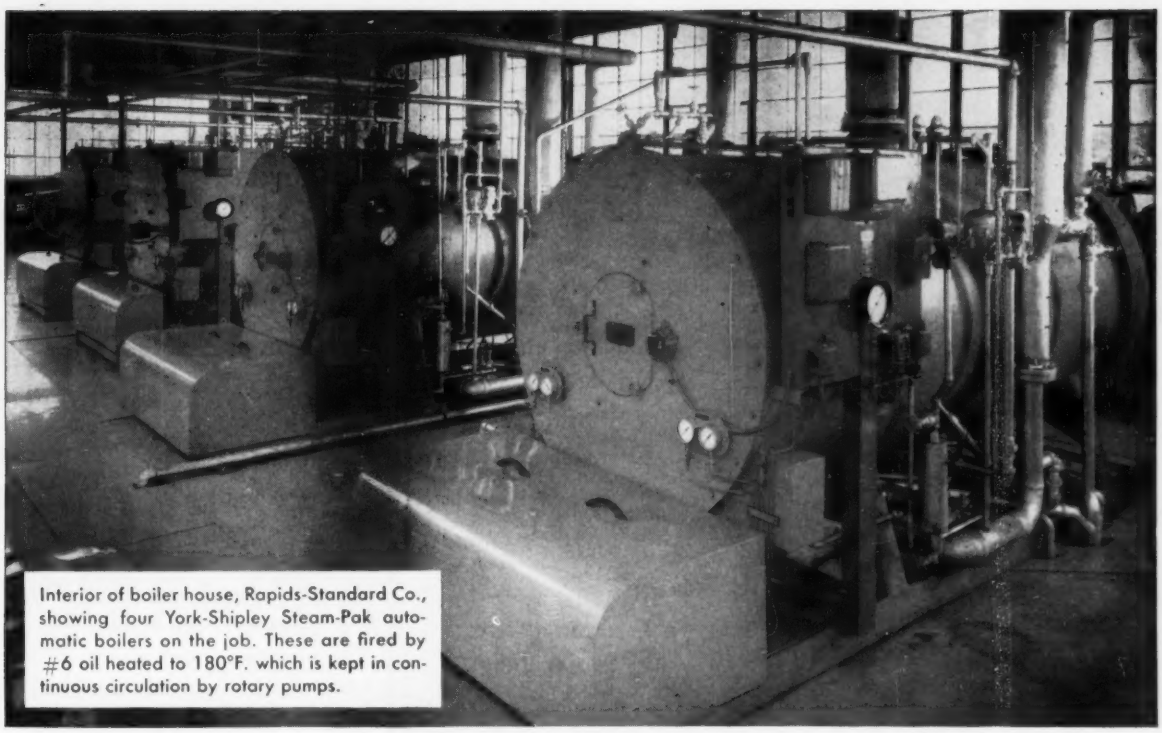
Oct 25-26—American Power Dispatchers Assn, fall national meeting, Fresno, Calif. Details from APDA, 3527 Glen Drive, Spring Valley, Calif.

Oct 30-31 — Industrial Management Society, 21st Annual Time and Motion Study and Management Clinic. Hotel Sherman, Chicago. Details from IMS, Suite 1310, 330 South Wells St, Chicago, Ill.

Nov 2-8—American Society for Metals, 2nd World Metallurgical Congress, Chicago, Ill. Details: Seward Covert & Associates, 530 Leader Bldg, Cleveland 14, Ohio.

Nov 3-7—Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, fall meeting, Institute of Metals Div. Morrison Hotel, Chicago, Ill. Details from AIMMPE, 29 W 39th St, New York 18, N. Y.

Nov 4-6—American Institute of Electrical Engineers, Ninth Annual Machine



Interior of boiler house, Rapids-Standard Co., showing four York-Shipley Steam-Pak automatic boilers on the job. These are fired by #6 oil heated to 180°F. which is kept in continuous circulation by rotary pumps.

They're saving money today . . . and looking after tomorrow, too!

How York-Power Steam-Paks more than doubled heating output . . . with no increase in building costs.

For more than eight years, two YORK-POWER Steam-Paks had been supplying ample heat for the Rapids-Standard Company in their Plymouth, Michigan plant.

The efficiency and economy records of these boilers were so high that when the time came to double plant facilities, company engineers realized they could do no better than to add two more Steam-Paks to take care of increased heating needs.

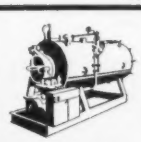
"From our particular view point," said Mr. Russell A. Inwood, Vice President of Engineering and Manufacturing, "the flexibility which YORK-POWER Steam-Paks provided for continuous expansion was of greatest importance. Also, because there were no expensive chimneys or foundations to construct, and because the units were pre-wired and pre-piped, we could cut down on installation costs."

SAVED BUILDING COSTS. Merely by rearranging the floor plan of the over-size boiler house, it was found that two more Steam-Paks could be set up . . . with *no extra building costs.* These four units now take care of all present heating needs and also provide for continued expansion for many years to come.

Find out how YORK-POWER Steam-Paks can help you. Our engineers are available to give full cooperation. Specification sheets and detailed data are yours for the asking. Write TODAY.

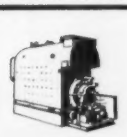
Industrial Division **YORK-SHIPLEY, Inc.** YORK, PENNSYLVANIA

ONLY YORK-POWER OFFERS A COMPLETE LINE OF AUTOMATIC BOILERS, BURNERS, AND FUEL BURNING SYSTEMS

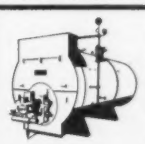


STEAM-PAK
15 to 600 Hp.
Oil and/or Gas Firing

STEAM-PAKETTE
10 to 50 Hp.
Oil and/or Gas Firing



FIRE-PAK
35 to 485 Hp.
Oil and/or Gas Firing



SCOT-PAK
52 to 400 Hp.
Oil and/or Gas Firing

ECONOL BURNER
5 to 28 G. P. H.
Oil Firing

ROTARY BURNER
18 to 400 Hp.
Oil and/or Gas Firing

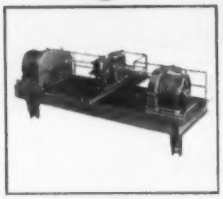
F/C SYSTEMS
Automatic Fuel
Burning Systems

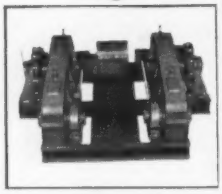
MURCO GATE HOISTS BACKED BY 75 YEARS EXPERIENCE

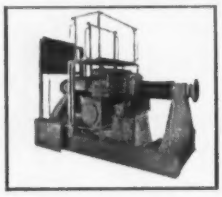
THE FIRST OF 18 GATE HOISTS FOR LONG SAULT DAM, ST. LAWRENCE POWER PROJECT

for any Size Power Dam

MURCO Gate Hoists are designed and built in a wide range of capacities from this large capacity to less than one ton. MURCO Gate Hoists have behind them 75 years of designing and building experience.







From this experience we have accumulated designs and patterns that may fit your requirements. In planning power dam gates, we suggest you write us before your plans for the project as a whole are completed . . it may save expense and important preparation time.

Write for complete information and Engineering Department recommendations

D. J. MURRAY MANUFACTURING CO.

Manufacturers Since 1883

WAUSAU, WISCONSIN

REPORTS from the FIELD

Begins on page 152

Tool Conference. Hotel Schroeder, Milwaukee, Wis. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Nov 12-14—National Association of Corrosion Engineers, Northeast Regional Meeting. Penn Sheraton Hotel, Pittsburgh, Pa. Details from NACE, 1061 M&M Bldg, Houston, Texas.

Nov 13-16 — National Association of Corrosion Engineers, short course. Key Biscayne Hotel, Key Biscayne, Fla. Details from NACE, 1061 M&M Bldg, Houston, Texas.

Nov 18-21—Air Conditioning and Refrigeration Institute, 10th Exposition of Air Conditioning and Refrigeration Industry. International Amphitheatre, Chicago, Ill. Details from the Institute, 1346 Connecticut Ave, NW, Washington 6, D. C.

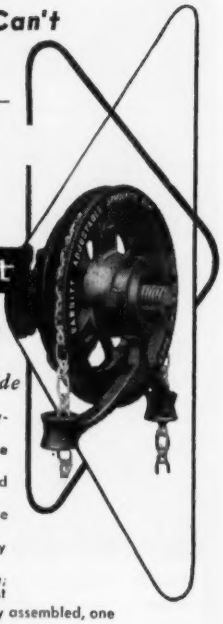
Okonite's North Brunswick plant swings into operation

► AFTER THE RIGORS of moving and the pleasures of opening, Okonite employees are settling into harness in their new plant. New plant located in North Brunswick, N. J., represents a stroke of luck for Okonite. Company officials had had a move under consideration for two years—congestion at three factories left no doubt of the need for additional facilities—but had found no suitable location. Then a former Studebaker plant, modern and unused, became available. Okonite moved in.

Decision involved closing down most congested plant at Wilkes-Barre, moving equipment to a new location to be added to necessary new equipment. New equipment, to the tune of $2,000,000, included extra wire drawing equipment, tinning equipment, a #11 Banbury and 84-in. sheeting mill, a 12-in. strainer, complete conveyor systems for these compounding and processing machines, 144-in. Adamson vulcanizer, two Davis-Standard continuous vulcanizing machines, a Robertson continuous lead extruder, a Robertson lead stripper, a six-conductor 60-in. cabling machine, a 42-wire 16-in. combination stranding and cabling machine, a 7-conductor 24-in. tubular cabling machine, a #3 Davis-Standard plastic extruder.

One of the most unusual features of the plant and one which Okonite cites with considerable pride is planning and operation of the electrical testing department. Testing department is centrally located so that it can take care not only of material as it passes through the factory but also of finished products. Shipping department is

Insurance Can't PREVENT ACCIDENTS— A BABBITT SPROCKET RIM CAN!



Babbitt

Adjustable **SPROCKET RIM** *with Chain Guide*

- Simplifies pipe lay-out
- Fits any size valve wheel
- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance; first cost *only* cost
- Packed, completely assembled, one to a carton
- Hot galvanized, rust-proof chain available for all sizes
- Easy to follow instructions with each unit
- Your supplier carries complete stocks
- Write for new descriptive catalog sheet and prices

Babbitt STEAM SPECIALTY CO.

2 BABBITT SQUARE, NEW BEDFORD, MASS., U S A.

Write for *Power's* REPRINT FOLDER

. . . giving

SUMMARIES *and* PRICES *on Power's* IINFORMATION-PACKED SPECIAL REPORTS

"the most useful condensed handbooks in the field."

POWER, 330 West 42nd Street
New York 36, N. Y.

Gentlemen: Please send me a copy of POWER's "REPRINT FOLDER".

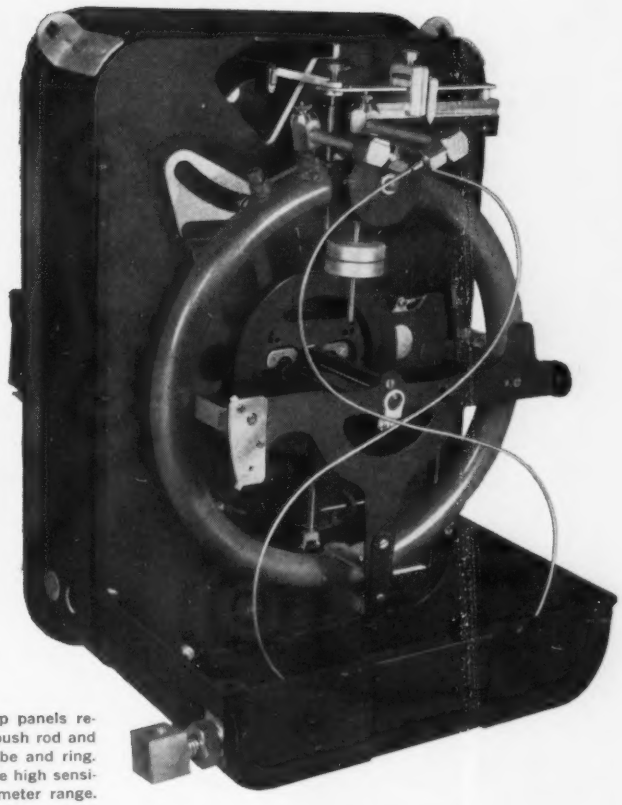
Name.....

Address.....

City & State.....

HAGAN RING BALANCE FEATURES—NO. 2

SAFE SENSITIVE METERING at 2500, 6000, 15000 PSIG



Rear of Ring Balance Meter with side and top panels removed to show S-tube arrangement. Note the push rod and resistant spring assembly, visible back of S-tube and ring. This feature of the Ring Balance makes possible high sensitivity at low flows and simple adjustment of meter range.

No question about it. The cylindrical tubing used to form the ring and S-tubes of the Hagan Ring Balance meter is the safe, sure means for containing high pressures. There are no gaskets or stuffing boxes to leak, blow out, bind or otherwise spoil this ideal design.

Pressure impulses are brought from the meter terminals to the ring through solid-wall S-tubes which, because of their special configuration and metal-to-metal fittings, provide safe, completely flexible connections and preserve the inherent high sensitivity of the meter.

New, rigid, weatherproof, die-cast, aluminum case. Four-piece back for complete accessibility.

Check these other Ring Balance features with your local Hagan office

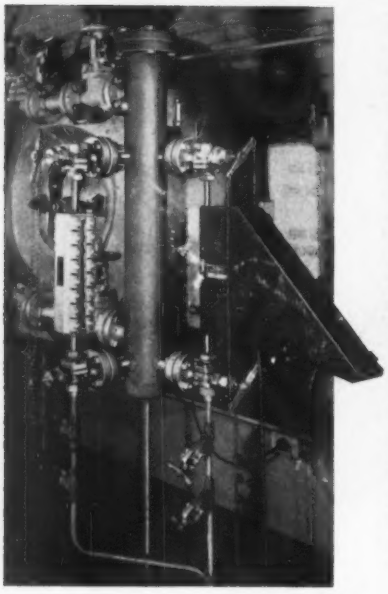
1. High sensitivity at low flows due to unique range calibration system.
2. Ease of calibration under operating static pressures with factory-calibrated check weights. No more four-story water columns and telephones.
3. Sealing fluid density and level not critical. No eye droppers required.
4. Interchangeable ring assemblies for full scale ranges from 0.5″ w.c. to 560″ w.c. Adjustment on any one ring over a 7:1 differential range.
5. Wide range computation and/or compensation by means of built-in, easily checked mechanisms available on most models.
6. Pneumatic or electric transmission also available.

Bulletin MSP-141 describes these features and the new design of the Hagan Ring Balance meter case. ASK US FOR IT.

HAGAN CHEMICALS & CONTROLS, INC.

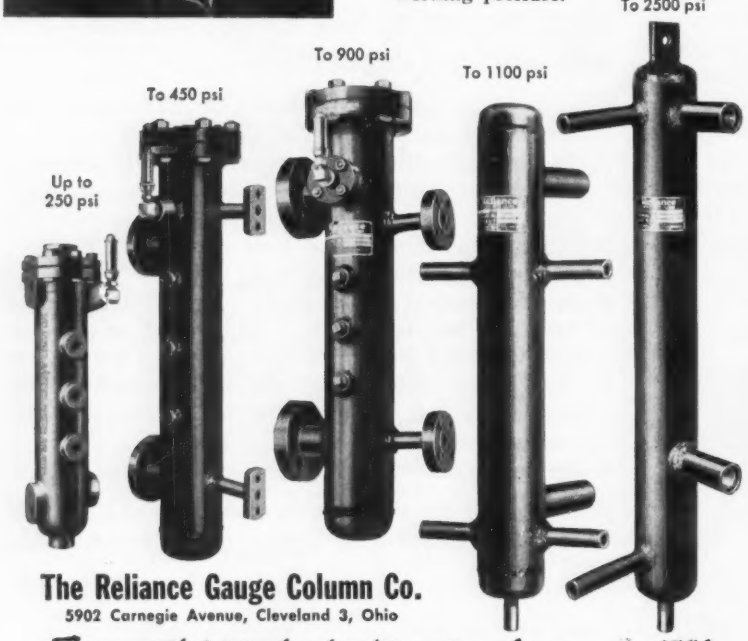
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED
OFFICES IN: MONTREAL, TORONTO, VANCOUVER, EDMONTON

Insure safe, continuous boiler operation with **Reliance** Water Columns



Water columns have been around for a long time — ever since Reliance introduced the first one in 1884. Its chief reason for existence then was to carry the float-operated whistle alarm and mechanism, to warn operators of dangerously low water in the boiler. Since then, the water column has been developed in various styles and capacities to meet any power plant need. They are used on most boilers today as an accepted necessity, although many old time engineers — and thousands of young ones — can't explain their full usefulness. If you'd like to know "why a water column", write for free copy of our Liquid Level Letter No. 11.

Reliance makes Water Columns in seven pressure categories, five of which are represented below. And complete "trim" — gage cocks, gage valves, gage inserts, special gages and direct-to-drum assemblies. Write for information on equipment suited to your working pressure.



The Reliance Gauge Column Co.
5902 Carnegie Avenue, Cleveland 3, Ohio

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

REPORTS from the FIELD

Begins on page 152

located just adjacent to the test area.

Voltages up to 78,000 volts can be handled by the present testing equipment. Tests are made after the reels have been submerged for eight hours minimum. These tanks have capacity of 20,000 gal, a pretty substantial swimming pool.

A safety lockout system prevents test voltage being applied when operators are in a test area. Transformers are completely shielded electrically. Grounding system grounds out all metal structures in the department. In addition, these test areas are shielded so that corona testing can take place without interference.

Control consols are located adjacent to the testing area and control room and will be air-conditioned. Test sets can be connected individually with each of the test areas and tanks.

In the immediate future, it is foreseen that the present group of 400 employees may grow to as many as 500. These will include approximately 100 salaried office workers and engineers. But now there is adequate land for any conceivable future expansion to meet growing needs of the electrical industry, which has been doubling nearly every ten years.

Plastic hot-water pipe U.S. Rubber research project

► A MAJOR STEP toward development of a plastic hot-water pipe—long a research target—has been taken by scientists of United States Rubber Co.

In laboratory tests water, heated up to the boiling point, and low pressure steam have been carried in pipe made from a new plastic, *Kralastic HTHT*, discovered by the company's chemists.

New material is said to combine the toughness of synthetic rubber with the mechanical strength of plastic. It was shown publicly for the first time at a press preview which preceded dedication of the company's new research center in Wayne, N.J.

Among the advantages cited in using plastic pipe were superior insulating properties which keep hot water hot for longer periods of time, less inclination, in cold-water lines, to sweat on humid days, no rust or corrosion, lower initial cost, and lower installation cost.

Products most immediate use is in radiant-heating pipes. Tests are also being conducted on this plastic as a carrier for hot acids. Initial major use for material will be in applications now using standard plastic piping.

How perfectly simple —this Fast's Coupling with purely mechanical flexibility!

1. A hub is keyed on each shaft. Hubs are splined at maximum distance from shaft ends.
2. Floating sleeves surround hubs. Sleeves are splined to engage hub splines.
3. Sleeves compensate for shaft misalignment by assuming neutral position between two hubs.
4. Because of distance from shaft end, any misalignment between splines is mere fraction of same misalignment between shafts.
5. Sleeves carried on bearing rings, located on transverse center line of hub spline faces (the load-carrying surfaces) . . . no crank action, no vibration.
6. Lubricant is centrifugally forced into spaces between engaged splines, forming a film.

For 35 years the most positive, dependable means of coupling machines to their power source . . . Fast's Couplings have no parts subject to repeated bending, tension or compression. Because there is no metal-to-metal contact, *there is no wear*—in fact, many Fast's Couplings in use for over 30 years show no signs of wear when disassembled! No leather, plastic or rubber oil seals. Lubricant film distributes pressure over a considerable area, diminishing localized stress at pressure points on the load-carrying teeth. Perfectly simple? Yes . . . and foolproof!

For coupling catalog, technical advice or assistance from Koppers field engineers, write: KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* 3310 Scott Street, Baltimore 3, Maryland.

THE ORIGINAL **FAST'S Couplings**

KOPPERS

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE 3, MD.
This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Industrial Gas Cleaning Apparatus, Aeromaster Fans.
Engineered Products Sold with Service.

SOLID WHEEL

spells non-stop turbine performance

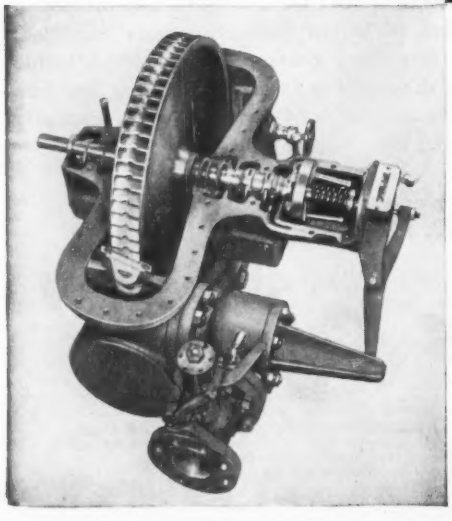
It's easy to see why Terry solid-wheel turbines have been setting non-stop records. They're built for long periods of continuous service.

The rotor, for example, is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out.

What's more, the blades can't foul. There is a one-inch clearance on either side of the wheel and the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets at right angles to the shaft.

You, too, can profit from Terry solid-wheel stamina. Bulletin S-116 gives full details. Send for a copy today.

THE TERRY STEAM TURBINE CO.
Terry Square, Hartford 1, Conn.



Action of steam in a Terry solid-wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

TT-1205

TERRY

why wonder?

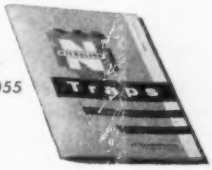
You can be sure you're getting a ready-to-go steam trap when you buy a Nicholson . . . because each and every one is tested in actual steam service before shipment.

And that's not all. With just one thermostatically-operated moving part, there's nothing to get out of order, nothing to go wrong. Nicholson means continuous operation of your steam-using equipment . . . no downtime from trap failure.

- **high air-venting capacity . . . for faster warmup of equipment.**
- **powerful valve action . . . no mechanical linkages to cause trouble.**
- **small and lightweight . . . easy to pipe and support.**

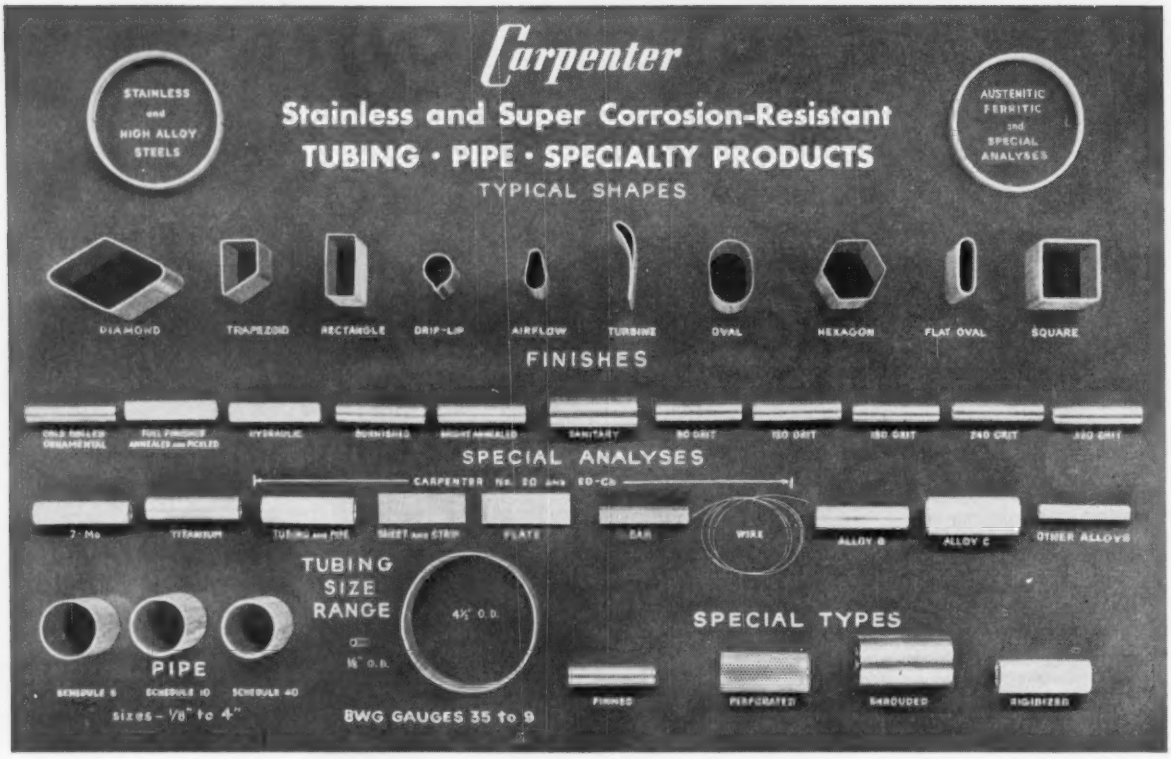
So, to get a trap that's service-tested, and loaded with operating features, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA., *Sales and Engineering offices in 98 principal cities.*

Write for Bulletin 1055



NICHOLSON

of Wilkes-Barre



Experienced hands at providing corrosion and heat control for nuclear power requirements

Your choice of over 35 analyses for
• corrosion resistance • heat resistance
• light-weight strength

AISI TYPES			SUPER CORROSION-RESISTANT TYPES
302	310	321	Carpenter Stainless No. 20Cb
304	316	347	Carpenter 7Mo
304L	316Cb	348	Carpenter Alloy B
309	316L	430	Carpenter Alloy C
309S	317	442	Titanium 55 and 70
309SCb	317L	443	

Other specialty grades in various stages of development are available: Zirconium, Zircalloy II, 19-9 DL, Invar, HiMu80, N-155, Haynes No. 25 (L-605), Hastelloy F and Hastelloy X, Armco 17-7PH, Titanium alloys, A-286 and others.

Here's why it will pay you to consult Carpenter about corrosion and heat-resistant tubing and pipe for pressure, mechanical, structural and sanitary requirements: The wide variety of types, grades, shapes, finishes and sizes illustrated can be supplied in the many standard and specialty analyses listed above. You benefit from over a quarter century of experience in helping the AEC, power companies and equipment builders solve a vast assortment of corrosion and heat problems. Millions of feet of Carpenter stainless and high alloy tubing and pipe have been supplied for various uses in many of the nation's top nuclear energy projects including A-power plants. Other large quantities have been installed in sampling lines, condensers, water treating equipment and other facilities in steam-electric power plants. Carpenter's meticulous quality control assures you of getting tubing and pipe of the highest possible degree of perfection. Technical and metallurgical assistance with your materials selection and fabrication and nation-wide service on your requirements are available through qualified Carpenter Distributors and Representatives in over 40 cities.

Put your problems in Carpenter's capable hands today. Ask for Bulletin T.D. 123.

MEMBER

The Carpenter Steel Company
Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

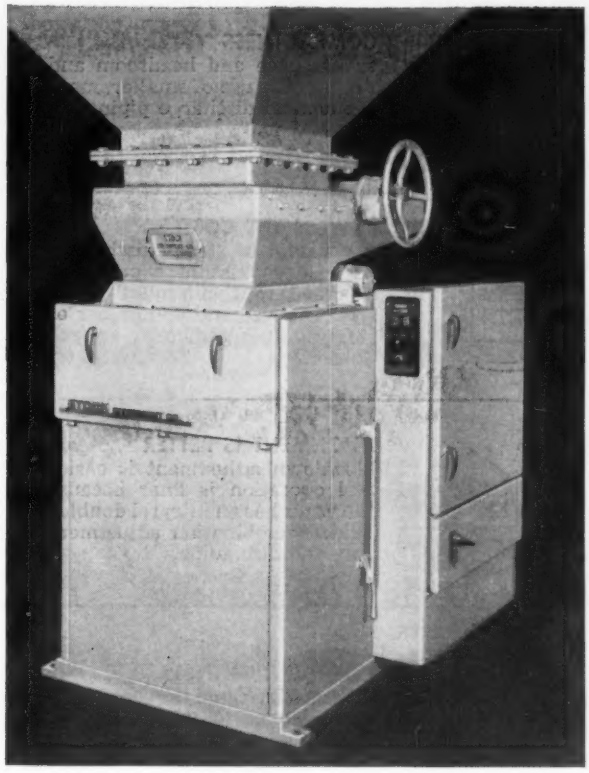
Carpenter

more than corrosion resistance

Stainless Tubing & Pipe

The new Stock Equipment Co.
Model 50 Coal Scale offers:

ACCURATE, CONTINUOUS COAL WEIGHTS... WITHOUT FAIL!



with little or no attention

Day-in and day-out operation, twenty-four hours on end without interruption, is a necessity for modern central stations and industrial power plants. The demand is for equipment to handle higher tonnages with less manpower—and Stock Equipment Co. is meeting that demand with a constructive design program that keeps its entire line up-to-date.

For example: The new Model 50 Coal Scale handles higher tonnages easily with its 500# stainless steel weigh hopper, extra wide feed belt and unrestricted flow of coal 24" wide straight through the scale. Anti-friction bearings are used throughout. Even the feed belt is carried on closely spaced idlers with anti-friction bearings carefully arranged for pressure lubrication from one point on each side.

Seventeen years of designing scales exclusively for power plant use make a S-E-Co. Scale the answer to your coal weighing problem. Write for help with your particular layout of Bunker to Pulverizer or Bunker to Stoker equipment to the address below.

STOCK Equipment Company
745-P HANNA BLDG. CLEVELAND 15, OHIO

ALL-PURPOSE SAFETY VALVE

REDUCES YOUR INVESTMENT FOR STEAM GENERATOR PROTECTION...

THE TYPE 1511 CONSOLIDATED SAFETY VALVE is today's best value in all-purpose safety valves for steam generator service. It is precision-built yet costs less than other valves for similar applications. Its high efficiency reduces the number of safety valves needed per boiler—saves maintenance time and costs. Compactness of design reduces the amount of space and head room required for installation and to operate the lifting lever.

There is no need to carry a large inventory of Consolidated Safety Valves. Stocks of valves are maintained at convenient warehouses where they can also be set to your specific requirements before delivery.

Since the Type 1511 was first introduced, its functional perfection and economy have unqualified acceptance from the power industry. Write for complete details about this efficient valve. Ask for Bulletin 730.

Type 1511 Consolidated Cast Iron Safety Valve. Sizes: 1½" thru 6". Full range of orifices. *Pressures:* Up to 250 psi. *Temperatures:* Up to 450° F.

COMPACTNESS
saves space and headroom and permits the use of smaller, more economical discharge piping.

LOWERS THE COST
per pound of steam discharged because maximum capacity is designed into minimum flange size. The size and/or number of safety valves per boiler are reduced.

ALIGNMENT IS BETTER
blowdown adjustment is easier and operation is finer because the valve has an integral double-guided combination adjustment ring and disc guide.

POSITIVE TIGHTNESS
is assured because the seat is machine-lapped to optical flatness.

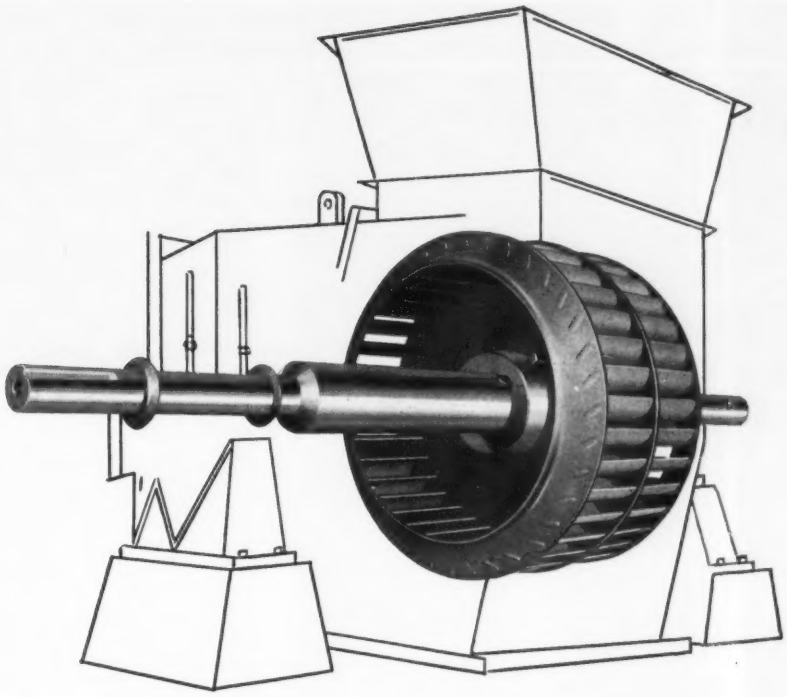
STABLE PERFORMANCE
is certain because the spring is exposed, and the blowdown control is uniform.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*



CLARAGE TYPE DN DYNACURVE FAN OFFERS A

New Concept

IN INDUCED DRAFT WHEEL DESIGN

36 radially deep, aerodynamically curved blades impart a dynamic energy to the gas stream to achieve low tip speed operation.

Unique shape of the blades and rims minimizes shock losses and turbulence at the entering edge of the blades and between the blades.

Wheel design assures relatively low moment of inertia (WR^2).

Wheel is constructed with a heavy forged steel hub and a sturdy centerplate.

All welded construction of the wheel provides ample shear strength, tensile strength, and rigidity.

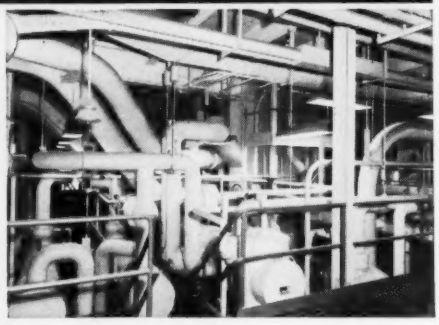
These are only a few of the features that make Clarage's new Type DN Dynacurve Fans fully equal to the most punishing demands.

Write today for Bulletin 905. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

BLAW-KNOX has what it takes—to provide these products and services



Heater piping system in this modern generating station is typical of many high temperature, high pressure systems prefabricated and erected by Blaw-Knox. Experienced piping engineers, modern shop facilities and a new Blaw-Knox digital computer method for fast, accurate calculation of piping stresses are available to you. Let us know your requirements and we'll provide the service you need. For more information, write for Bulletin No. 2443—"Piping for Industry."

Out of every 100 firms who lose their records in a fire, 43 never reopen for business. Be safe. Let a Blaw-Knox fire-protection engineer study your needs—and explain how you can pay for the system on our lease or deferred payment plan. To get more information send for Bulletin No. 2426—"Fire Can Destroy Your Business."

Blaw-Knox trapeze functional spring hanger installed in first large atomic generating station. Vital power piping system for the atomic generating unit in the Duquesne Light Company's Shippingport Station is supported by Blaw-Knox custom-engineered hangers.

Blaw-Knox makes a complete line of standard and custom-engineered pipe hangers, supports, and vibration eliminators. Each is a complete packaged unit, designed for a specific purpose and constructed to comply with the "code for pressure piping." Available in types and sizes to meet varying conditions, ready to install.

Blaw-Knox engineers, who have solved many difficult hanger and piping vibration problems, are always available to both design and make recommendations for your hanger requirements. For further information, write for Catalog No. 54.

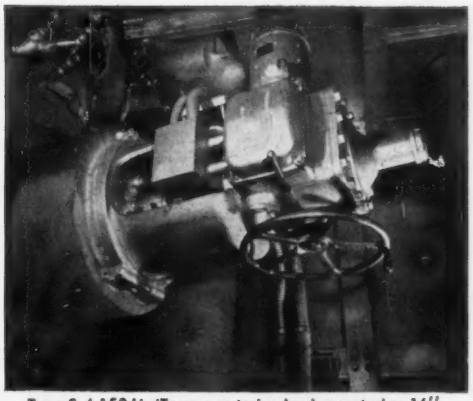
BLAW-KNOX

BLAW-KNOX COMPANY

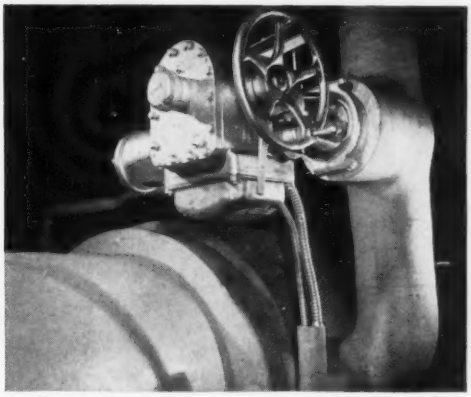
Power Piping and Sprinkler Division

829 Beaver Avenue • Pittsburgh 33, Pennsylvania

Complete facilities for prefabrication and erection of piping systems for all pressures and temperatures ... complete line of standard and custom-engineered pipe hangers, supports and vibration eliminators ... complete line of automatic sprinkler systems for standard and special hazards



Type S-4-150 LimiTorque motorized valve control on 16" main steam stop valve, under 1880 psi and 1005°F.



8" high pressure feed water heater isolation valve with Type SM-3-60 LimiTorque motorized valve control operates at 2000 psi, 505°F.

LimiTorque®

assures safe, trouble-free valve operation

. . . at Milliken Station, the sixth and latest in the New York State Electric & Gas Company System, LimiTorque automatic valve controls provide rapid, safe and positive valve operation for normal use or where emergency may require immediate operation from a distant point. Quick, accurate control of steam flow and maintenance is assured. No personnel is needed to manually operate valves, however, if necessary, LimiTorque can always be manually operated through a safe powerful hand wheel control.

LimiTorque Valve Controls can be mounted on any size valve in nearly any position or location. LimiTorque can be readily adapted to existing equipment with electricity, hydraulic pressure, air or high pressure natural gas used as power sources.

LimiTorque provides constant seating thrust . . . assuring an absolutely tight valve on each closure while at the same time, protecting all valve operating parts from overload. Adjustment of the torque limit switch enables operating personnel to compensate for valve wear throughout the life of the valve.

Insist on LimiTorque to protect your valves

OPERATING AT 1880 psi AND 1005° F

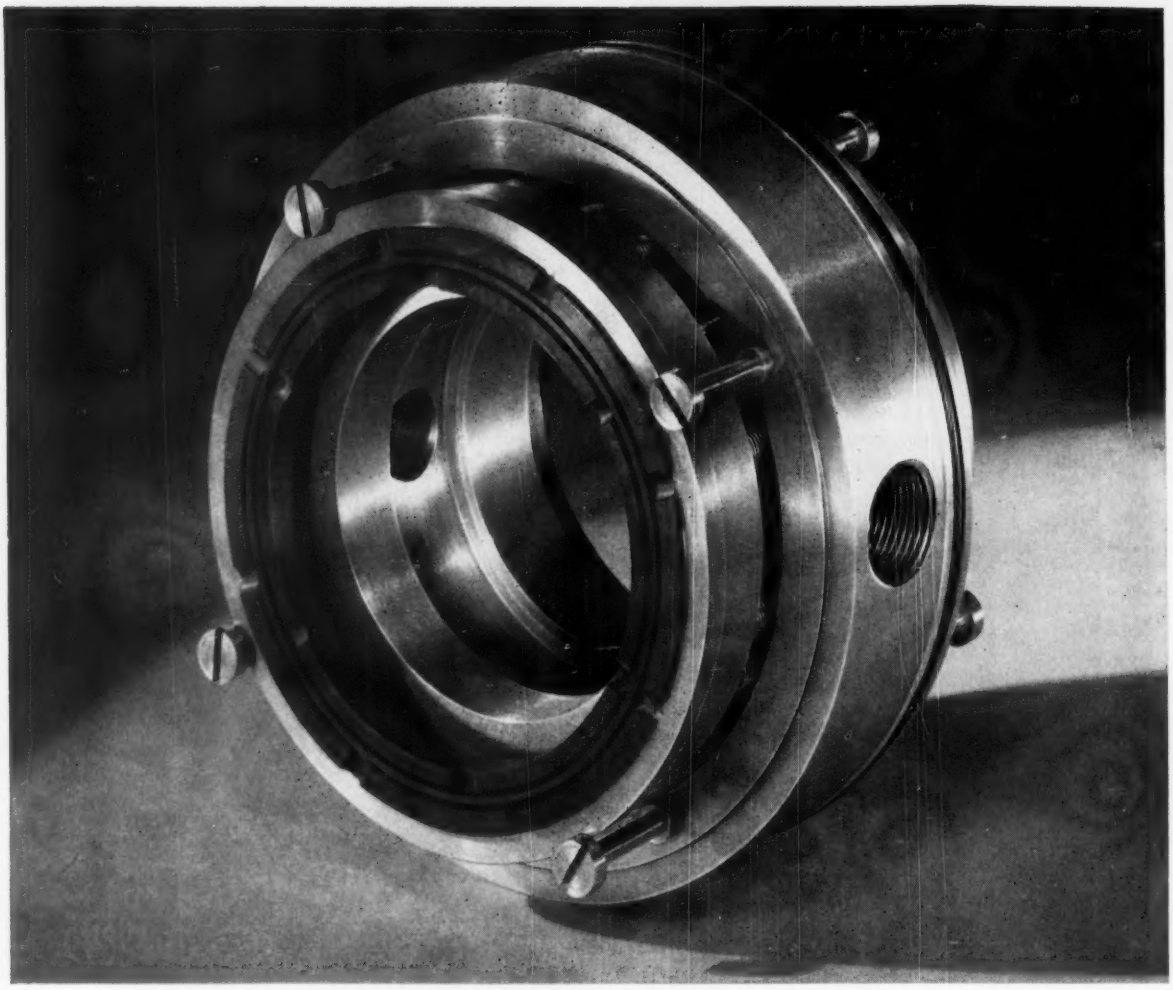
On the banks of beautiful Cayuga Lake in Upstate New York, Milliken Station represents many refinements in modern steam-electric design.

LimiTorque®

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia



Koppers Face Type Seal Provides Up to 20,000 Hours of Service!

Up to 30,000 Hours in Laboratory Tests Using Clean Gas!

Koppers engineering has created an unmatched sealing surface that gives Koppers Face Type Seals a much longer-than-ordinary service life.

The exclusive design of the sealing surface keeps pressure distribution and hydraulic balance unchanged during operation . . . permits a light face loading which lowers interface temperatures. Hydraulic balance allows sealing of gases and liquids through a wide range of rubbing speeds. Rugged construction adds to Koppers long service life. Rotating collars can be of hardenable stainless steels, cutlery and die steels, Stellites, or of a hard chromium or carbide face. Ring is of carefully selected grades of carbon.

If you have a sealing or piston ring problem, Koppers entire research, production and engineering facilities are at your disposal. For more details, write to the KOPPERS COMPANY, INC., 2110 Hamburg St., Baltimore 3, Maryland.

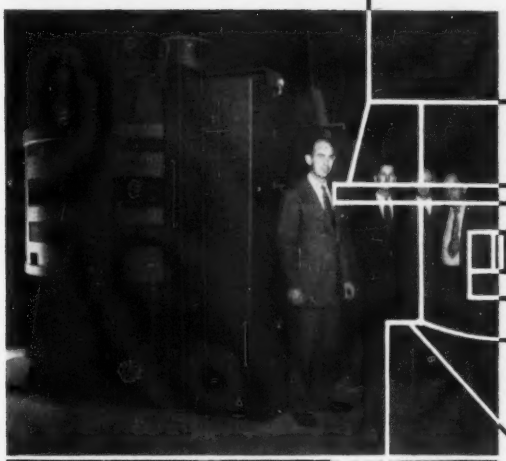
Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

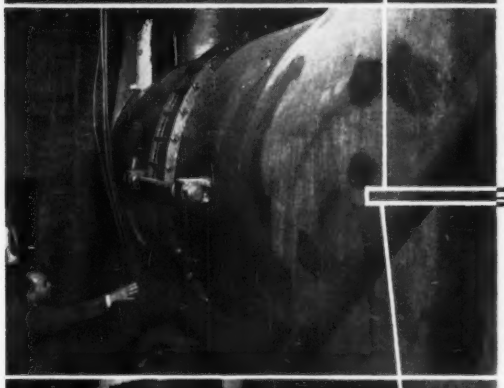
***Engineered* Products**
Sold with *Service*

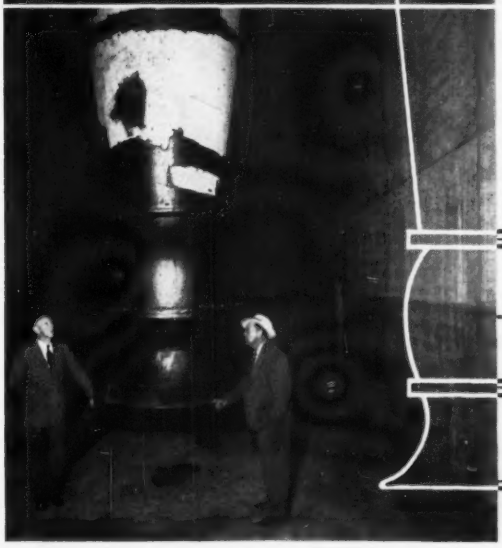
KOPPERS®

MECHANICAL SHAFT SEALS

GET THE BIG PUMP FOR THE BIG JOBS







PEERLESS PUMPS

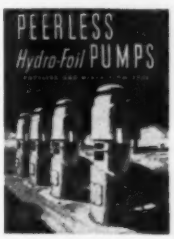
PEERLESS HYDRO-FOIL PUMPS

ON CONSTANT STANDBY FOR UNFAILING OHIO RIVER FLOOD CONTROL

A flood control pump has a big responsibility. It must become operative instantly when the emergency arises and run continually for as long as the emergency exists. That's why the U. S. Corps of Engineers used Peerless 66" and 72" Hydro-Foil pumps on a recent flood control project at Louisville, Kentucky. They know that the big Peerless Hydro-Foils are as dependable and well-built as they are large.

The Louisville project consists of 17 miles of flood wall and 14 pumping stations, all designed to handle the Ohio River when cresting above flood stage. Typical of the pumps used in the pumping stations is the huge mixed flow Hydro-Foil pictured at left. This imposing giant of the pump world is capable of moving 103,000 GPM, against a 20½ ft. head, and is powered by a vertical synchronous motor operating at 360 RPM.

This is only one of the many Peerless pumps available to all industries for every purpose—pumps that reflect the sound engineering, quality of manufacture and uncompromising performance that has made the Peerless product the finest in the field today. Whatever your liquid transfer problem is, Peerless has the answer—the right answer. Consult your phone directory for the nearest Peerless sales-engineering representative.



Write for Bulletin

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, California

Please send copy of Peerless Bulletin No. B-148.

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

POW

ACCO
for Better
Values

R-P&C VALVES

THE COMPLETE LINE
—DESIGNED FOR DEPENDABILITY

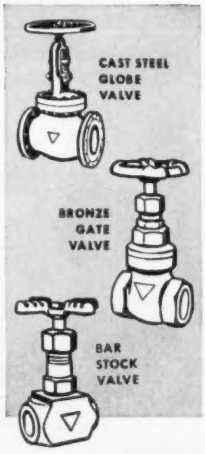
Created by R-P&C—made and sold exclusively by R-P&C...Electric Furnace Iron Valves

Electric furnace iron—introduced exclusively in R-P&C Valves—provides a high quality cast iron that meets the exacting requirements for pressure castings. Melted and refined under closest metallurgical supervision, R-P&C Electric Iron has physical properties *far exceeding the minimum standards* to which they must conform. It has a balanced chemical composition and a tough, dense body structure; and, it is more resistant to corrosion. All cast iron parts of R-P&C Valves are made of this Electric Furnace Iron.

Shown above is **Fig. 625**, a general service valve which is particularly applicable where full, unobstructed flow is desired. This type, available in bronze-trimmed or all-iron style, either flanged or screwed, is made in fifteen sizes, from 2″ to 24″—and is typical of the better values offered by the entire line of R-P&C Electric Iron Valves.

The R-P&C Line is Complete

The R-P&C line embraces gate, globe, angle and check valves in bronze, electric furnace iron and cast steel, and forged steel; all in a wide range of sizes, styles and pressure classes. Also, R-P&C offers specialties such as Lubrotite gate valves, bar stock valves, asbestos-packed cocks, cast steel fittings and pressure-seal cast steel valves. Order through your nearby R-P&C Distributor. For complete catalog, write our Reading office.

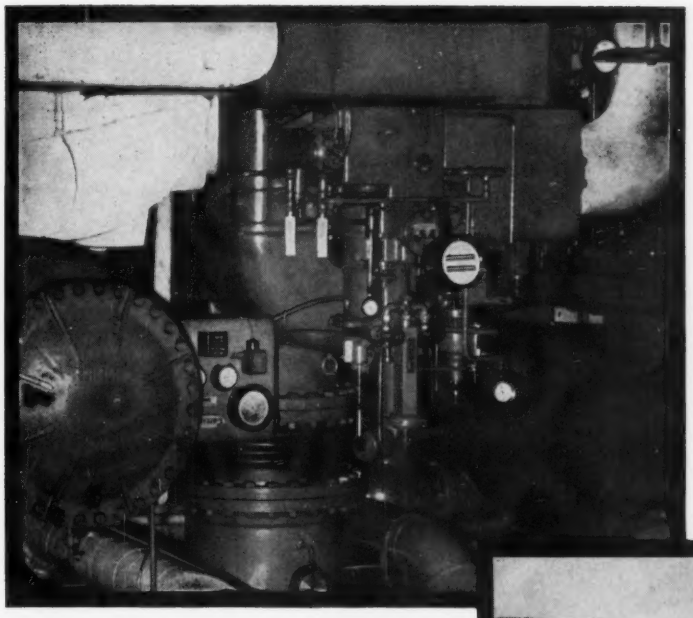


FREE WALL CHART
"*How to Protect Your Valves*"
Installation pointers, operating tips, clues to longer valve life. They are all on this 22″ x 17″ wall chart. Write for your free copy.

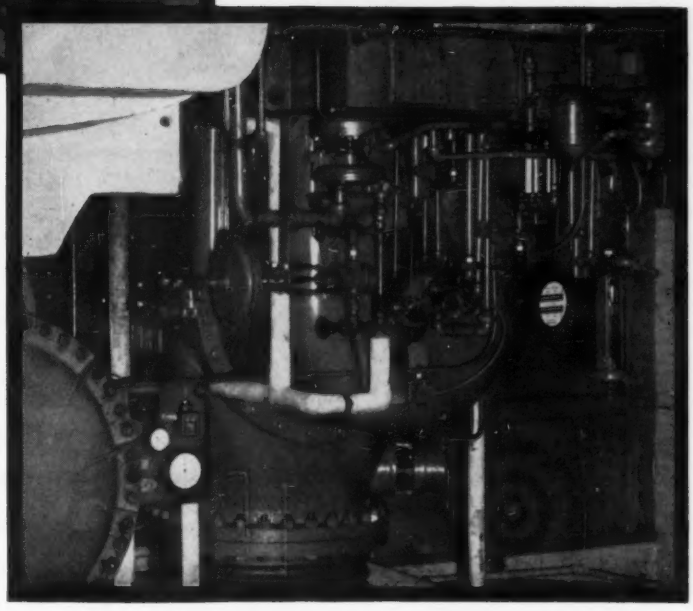
R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

ACCO
TRADE MARK



1948—For air conditioning drive B. Altman & Co. installed a Murray low pressure turbine providing 633 HP at 5010 RPM.



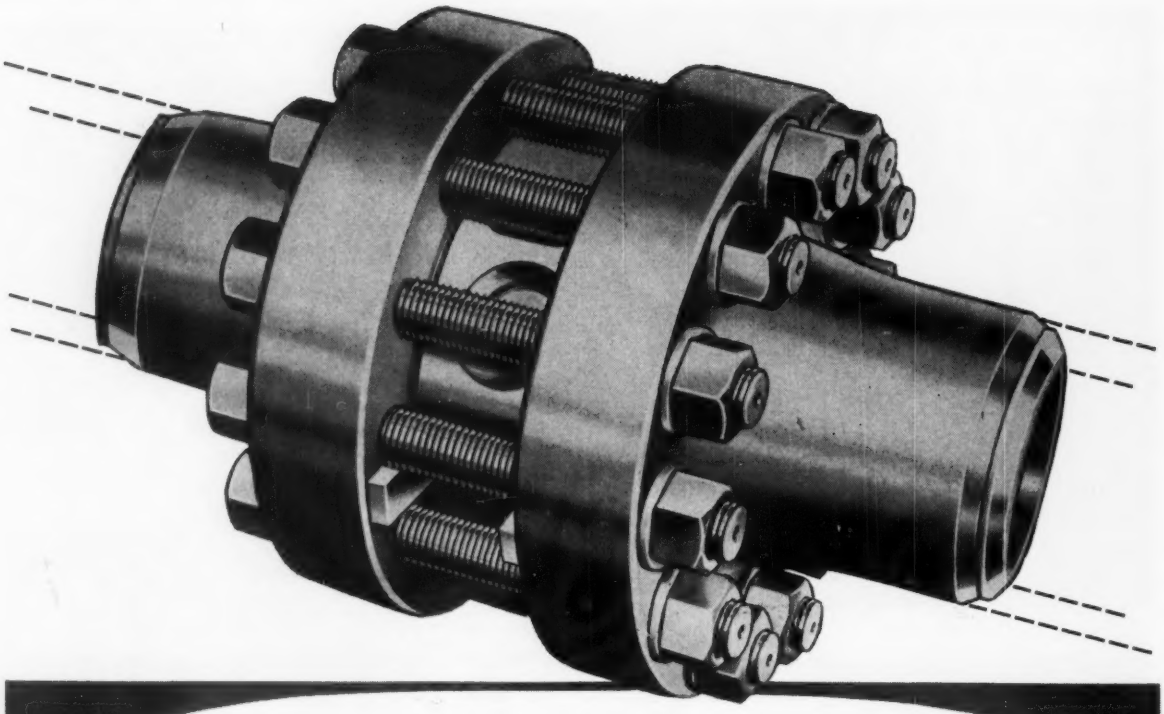
1950—Again B. Altman & Co. selected Murray to drive another air conditioning unit with a 905 HP, 3880 RPM low pressure turbine.

ALTMAN'S SCAVENGES LOW PRESSURE STEAM FOR AIR CONDITIONING DRIVE

B. Altman & Co. in New York City are utilizing low pressure steam to power the air conditioning of their large department store at 34th Street and Fifth Avenue. Economical Murray turbines operating on exhaust steam at only 2# gauge pressure provide the smooth dependable power for the store's two centrifugal compressors. Your low pressure steam can be utilized just as effectively to drive any type of machine. Murray's low pressure turbines are developing as much as 2200 HP in a single turbine and of course Murray's long experience assures you af an added plus value of service and long life.

Consult your local Murray representative who will be pleased to show you ways of utilizing your low pressure steam. MURRAY IRON WORKS COMPANY, Burlington, Iowa.

★★ **Murray Turbines** ★★



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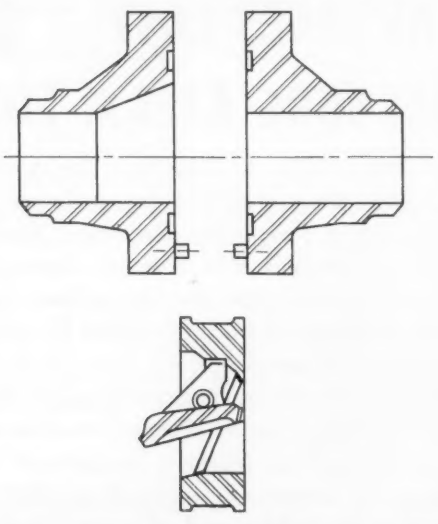
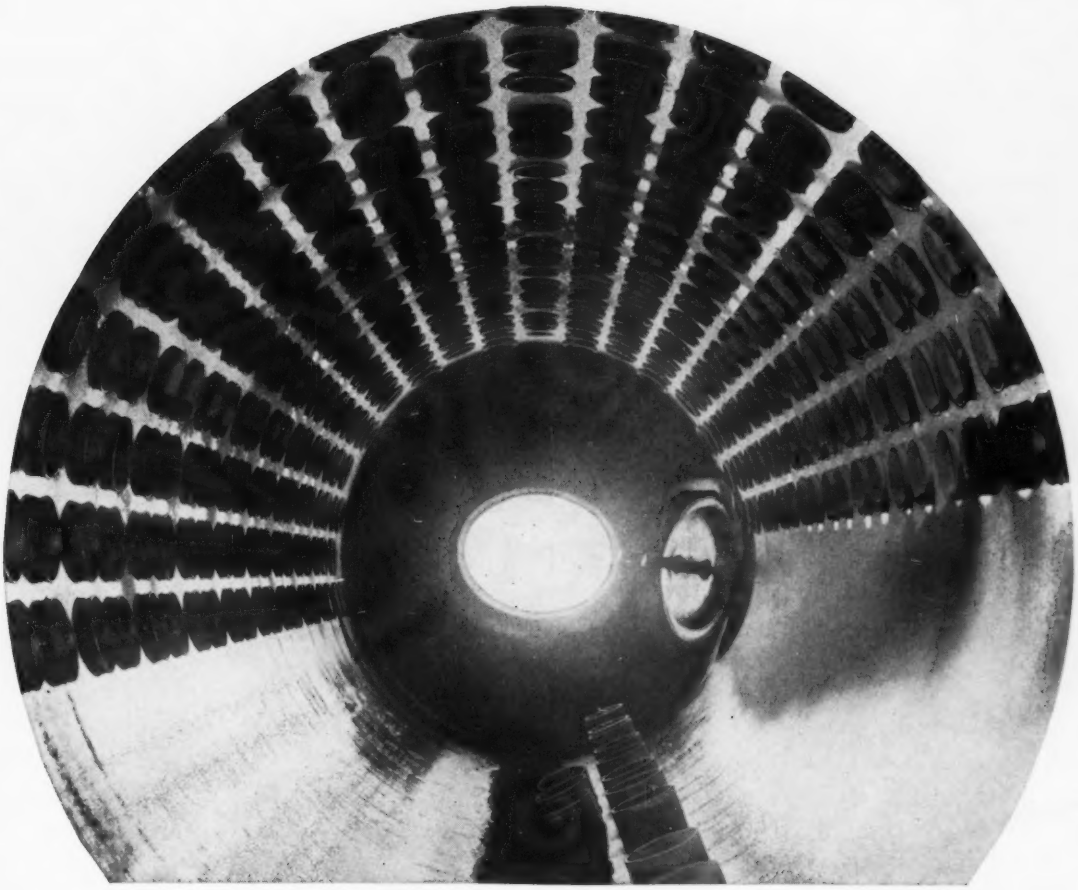
If you don't have complete information on this and other Chapman Tilting Disc Check Valves, write for it, today. We'll get it into your hands, fast.

. . . just remove the center section



The Chapman Valve Manufacturing Co.

INDIAN ORCHARD, MASS.



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When this mud drum was opened for inspection, it looked just as everyone expected it would—clean as a whistle, completely free of sludge and scale—after nine months of treatment with Dearborn Formula 659. That's product dependability.

Formula 659 contains a patented* Dearborn Polyamide Anti-Foam that provides protection throughout the entire water-steam cycle. In addition to improving steam quality, Formula 659 also conditions sludge, reduces blowdown requirements, and controls corrosion.

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FORMULA 659 permits higher boiler water concentrations, thus reducing blowdown.

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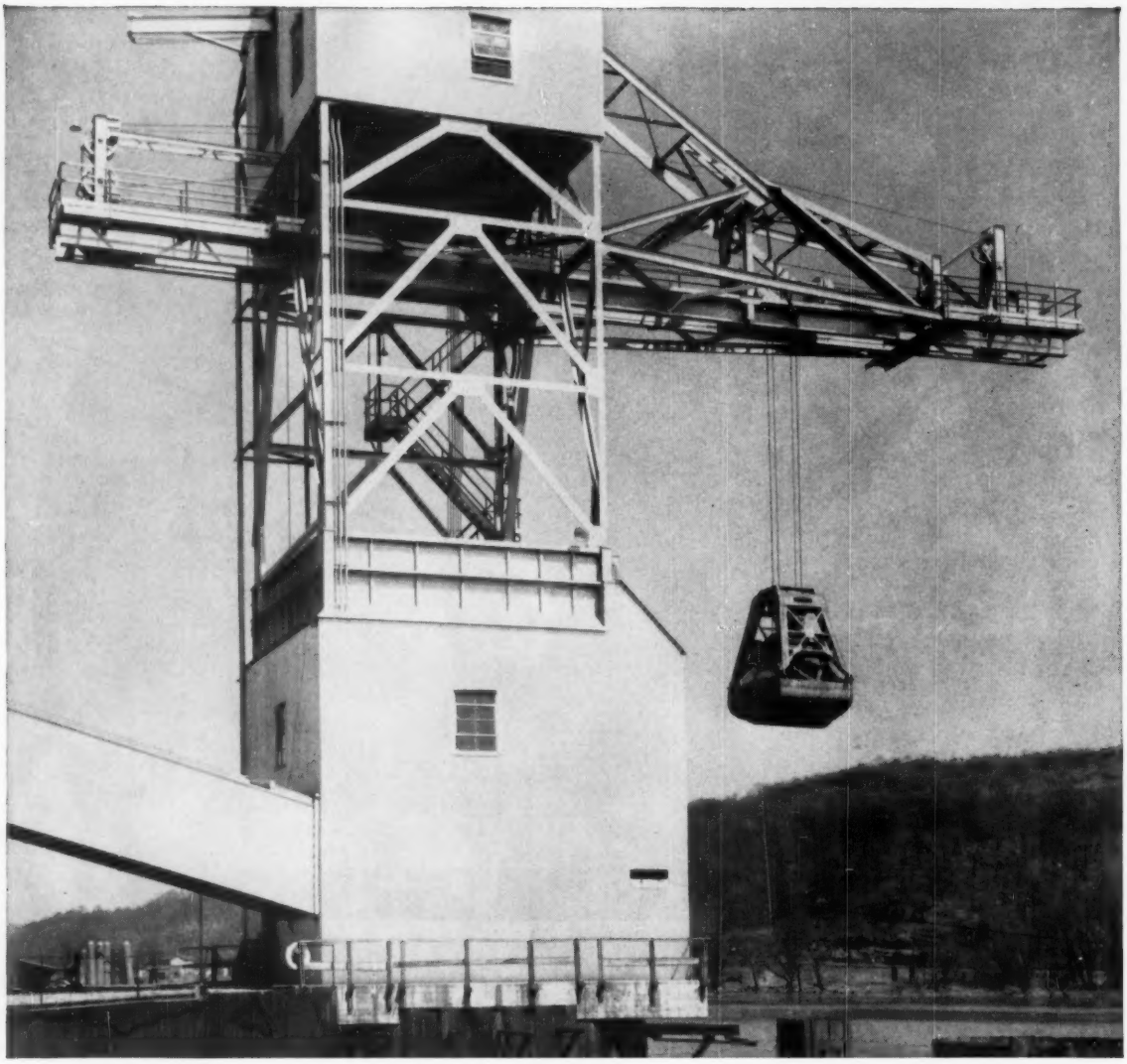

Rope-operated coal unloader designed, built and installed by Dravo for a large generating plant on the Monongahela River

Efficient tower keeps coal unloading costs down

This Dravo rope-operated unloading tower, installed on a Dravo dock is equipped with a 7½ ton bucket. With an operating cycle of 34 seconds from barge to hopper, the tower has a free digging capacity of 800 tons per hour.

Dravo towers feature all-welded construction, a reeving system that reduces hoisting horsepower, independent, positive bucket closing and many other design advantages that mean low cost operation.

The Dravo cellular steel sheet pile dock requires no maintenance, and provides safe mooring for barges. It may support barge shifters and other auxiliary equipment as well as the unloading tower itself.

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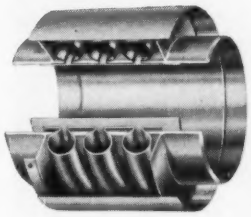
NEW ZALLEA HyPTor* TOROIDAL EXPANSION JOINT



HyPTor corrugations have a circular or toroidal cross section which provides a lower operating stress at any given pressure than any other corrugation shape.

For unequalled endurance at pressure and temperature extremes

This unique toroidal expansion joint with thin-walled bellows is setting new performance and durability records in high pressure, high temperature service. It was developed to meet the severest operating conditions without sacrificing long life.

Minimum stress at high pressures is one advantage of the Zallea HyPTor. This is due to the thin-walled bellows and toroidal corrugations. Thin walls develop lowest flexing stress. The toroidal cross section assures lower operating stress at any pressure.

Superior performance at high temperatures. The toroidal corrugation of the HyPTor makes it suitable for use at high temperatures. Also, the HyPTor is hydraulically formed and free from circumferential welds which would act as stress raisers.

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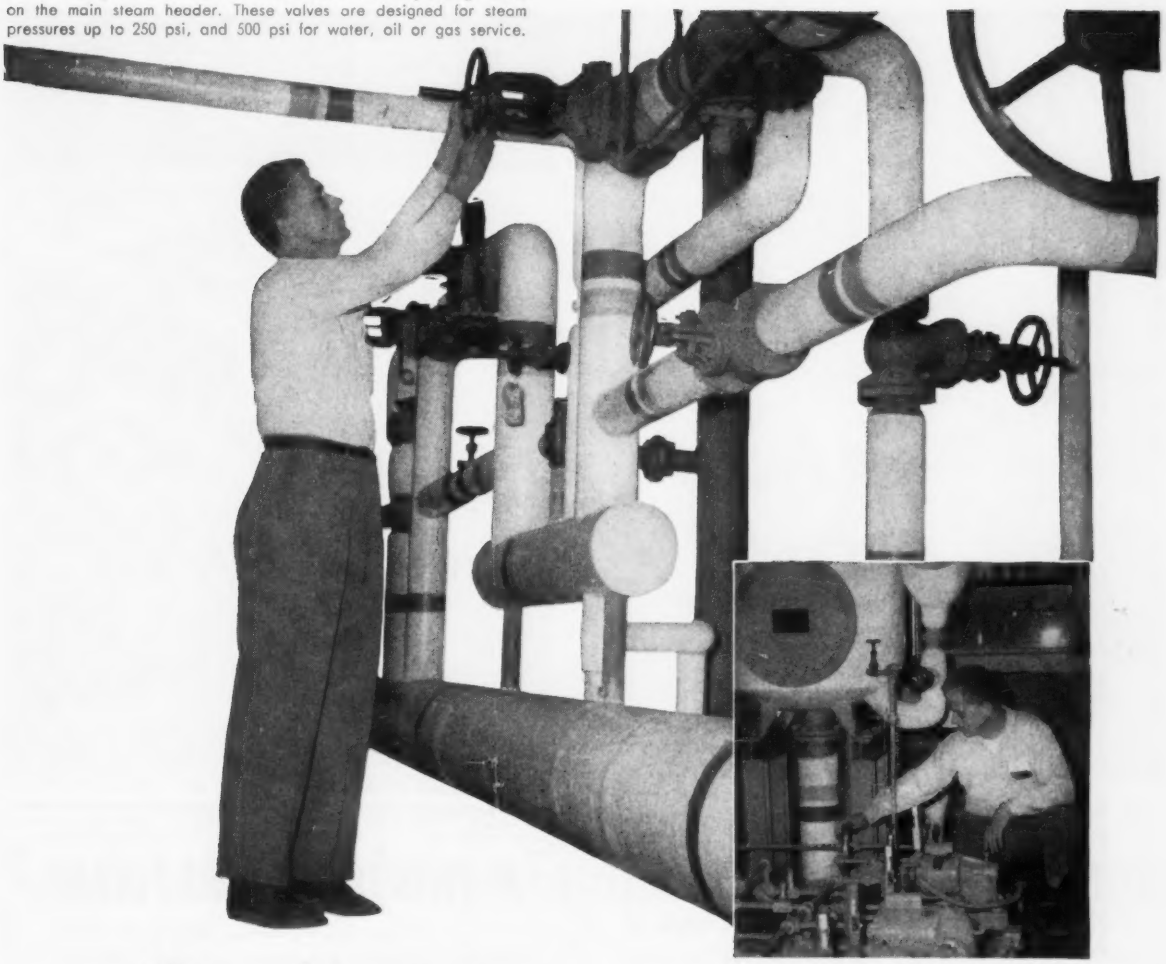

Chief Engineer Bruce W. Martin checks Walworth Bar Stock Valves in chemical feed pump lines to boiler and feed water. These carbon steel valves are built for ratings up to 3000 psi. Stainless steel bar stock valves are also available for very severe service.

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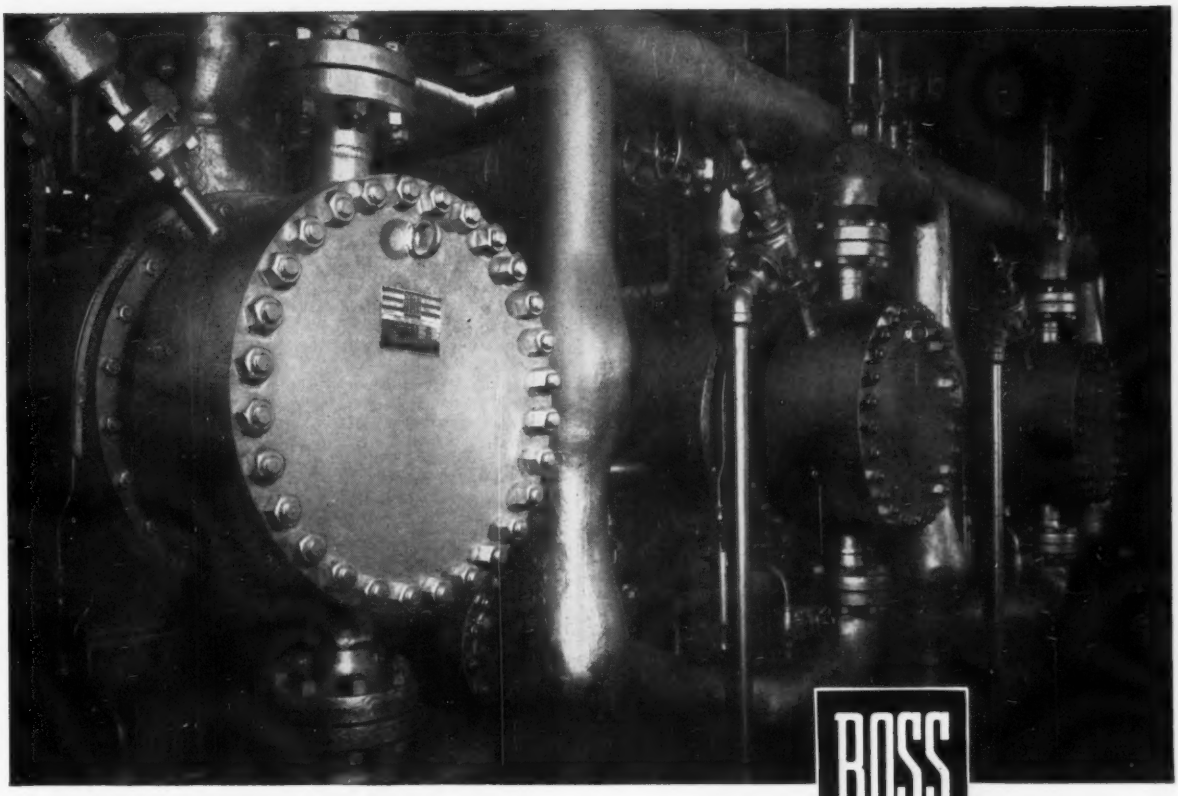

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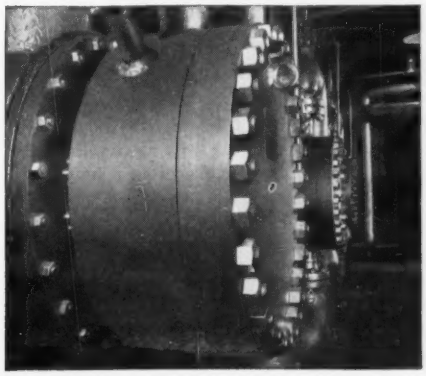

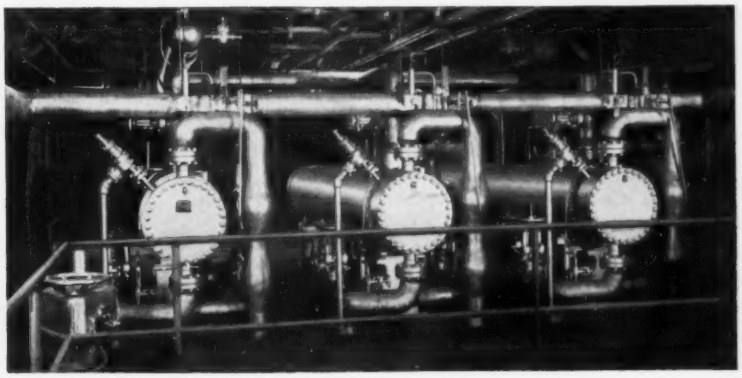

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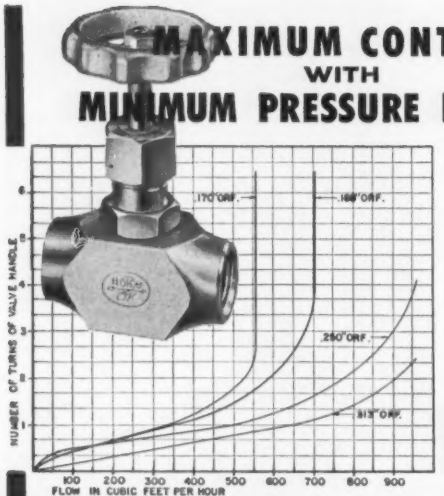

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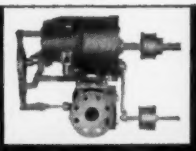

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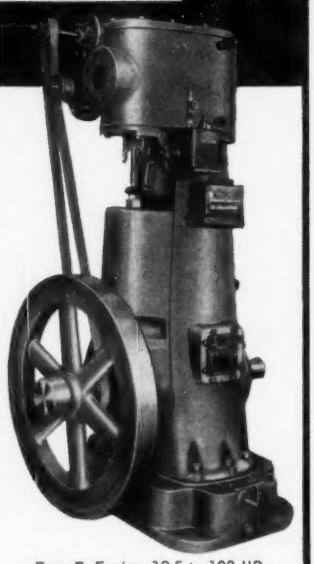

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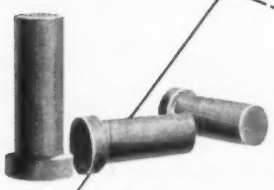

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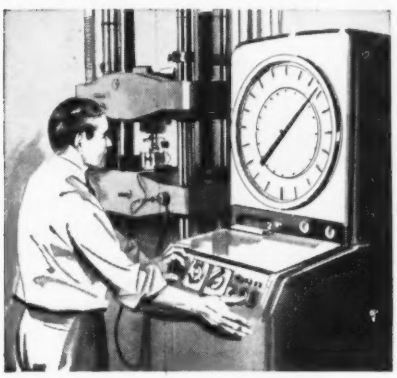

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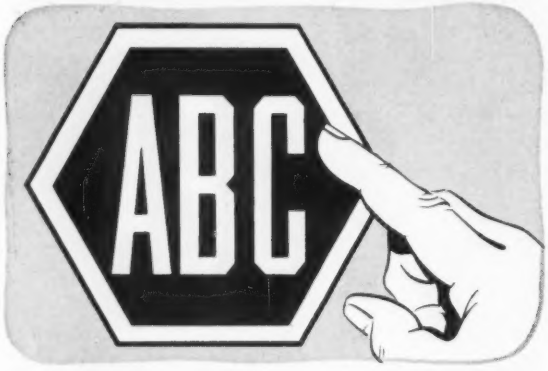

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J. E. SIRRINE COMPANY
Engineers
Power Plant Consultations
Design Reports
Water Steam Utilization Plants
Greenville South Carolina

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WATER SERVICE LABORATORIES, INC.
Specialists in Water Treatment for Corrosion Prevention
Main Office:
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THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

Power Station Superintendent and Assistant

An independent utility located in central South, presently constructing a large modern steam-electric generating plant, has immediate opening for heavy-experienced and capable talent to assume responsible positions of:

Power Station Superintendent

Requires mechanical or electrical engineering degree, or equivalent, with a minimum of 20 years' experience in central station supervision, operation and maintenance Age to 55.

Assistant Superintendent

Requires mechanical or electrical engineering degree, or equivalent, with a minimum of 12 years' experience in central station supervision, operation and maintenance. Age to 48.

Liberal benefits include group life insurance, hospital and surgical coverage, vacation and retirement plan.

Please forward comprehensive resume in complete confidence to:

Mr. C. E. Schaefer,
Personnel Manager

Burns and Roe
INCORPORATED
Engineers & Constructors
160 West Broadway
New York, N. Y.

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant
Positions Wanted
Part Time Work
Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered
Employment Agencies
Employment Services
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The advertising rate is $25.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

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Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS to Class. Adv. Div. POWER, P.O. Box 12, N. Y. 36, N. Y. for November issue closing October 8th.

WANTED
DIRECTOR-RESEARCH & DEVELOPMENT

•

A large manufacturer of heavy equipment wants an able engineer-scientist to direct research and development.

REQUIREMENTS:

Age to 48. Advanced degrees in Mechanical Engineering or Metallurgy, with special knowledge in some of the following fields:

Thermo-Dynamics
Nuclear Physics
Power Plant Design
Marine Engineering

Experience should include some years of high-level responsibility in direction of engineers and scientists in research in above activities.

LOCATION—New York City

Compensation—$20-$25,000, depending on background, experience and EXECUTIVE capacity.

Send resume, in duplicate, for confidential appraisal to:

P-6203, POWER
Classified Advertising Division
P.O. Box 12, N. Y. 36, N. Y.

ELECTRICAL ENGINEER

Good opportunity for Electrical Engineer 28 to 35 years of age, who has a college degree and five years of experience to locate with large paper manufacturer in northern New England. Work includes supervision of design layout and installation of all types of electrical equipment as well as supervision of electrical repairs and new construction. Salary will reflect previous experience.

P-6084, POWER
Class. Adv. Div.
P.O. Box 12, N. Y. 36, N. Y.

WANTED MACHINE SHOP SUPERINTENDENT FOR NEW TEXTILE PLANT IN SOUTH CAROLINA

Very good opportunity for capable man—Permanent job. Experience in machine tools and design necessary. No textile knowledge required. Please give full details—including background, education, references and salary in your reply.

P-6142, POWER
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

ENGINEERS

If you have been looking for an Employment Agency that is skilled in the **STATE OF THE ART** of Technical Recruitment and **RELIABILITY OF INFORMATION** concerning positions, why not communicate with us at once! **ALL POSITIONS FEE PAID.**

FIDELITY PERSONNEL SERVICE
1218 Chestnut St. Phila. 7, Pa.
Specialists in Aviation, Electronics and Nucleonics

MAINTENANCE SUPERVISOR

Age 30-65. Large midwest hospital. Supervise all aspects of building maintenance and assist in the planning of new constructions. Write giving complete personal background and salary requirements.

P-6025, POWER
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.): Address to office nearest you c/o this publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Designers — Electrical — Piping — Struct. . . . Power Plants and Industrial Buildings. Marbarry Corp., 120 Greenwich St., New York City 6, N. Y. REctor 2-3749.

Wanted—Experienced young man capable of taking charge of Electrical maintenance, distribution and construction, in a medium sized, midwest paper board mill, Division of a National Company. Technical background necessary. Please give complete details in first letter. P-5936, Power.

Maintenance—Plant & Electrical Engineers. Long Range Program. Maintenance & Operation of Power Plants, Diesels & Steam Plants for Military Airbases. P-6195, Power.

Mechanical Engineer—Responsible position open with leading New York City Consulting Engineering firm. Applicant should have experience in supervision of power, hydraulic and general piping projects. Send complete resume including salary requirements. Replies will be held confidential. P-6183, Power.

SELLING OPPORTUNITIES OFFERED

Water conditioning equipment manufacturer desires agents for North and South Carolina and Georgia. RW-3789, Power.

Established manufacturer with complete line of water treatment, fuel oil treatment and soot remover products desires representation in New England and Midwest areas. Excellent opportunity for men with allied lines and following in industrial power plants. High Commissions. RW-4655, Power.

POSITIONS WANTED

Chief Draftsman: Graduate M.E. with 15 years piping, structural, mechanical, electrical and concrete drafting experience. PW-6182, Power.

Power Plant Superintendent, age 36, technical education, 12 years experience in the operation, maintenance and plant betterment of turbo-electric power plants. PW-6213, Power.

SELLING OPPORTUNITY WANTED

Engineer wishes to represent manufacturer of equipment for heavy industrials central and eastern Penna., Del. RA-6153, Power.

CLASSIFIED **SEARCHLIGHT SECTION** ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

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EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NE WADVERTISEMENTS or Inquiries to Classified Advertising Div. of Power, P. O. Box 12, N. Y. 36, N. Y. for November issue closing October 8th

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

WANTED

1800 HP 252 RPM 2300/3/60 Slip Ring Motor.

SOUL CLINIC, INC.
Calgary, Alberta, Canada

WANTED

Complete power plants, turbo generators, Boilers, Condensers, Engine generators, Processing Plants and equipment.

PAUL OBERMAN
1910 Delmar St. Louis, Mo.

GET CASH NOW

for your new surplus motors, controls and transformers!

NEW MOTORS AVAILABLE:

Over 5,000 *new* motors, *in stock*, from ¼ HP to 200 HP. Special low prices.

Write, wire or phone collect!

AJAX ELECTRIC MOTOR CORP.
P.O. Box 262, Rochester, N.Y.
Long Distance Phone LD. 132

FOR SALE

Pick Instantaneous Tankless Hot Water Heater. 200 gallon per minute capacity.

WHITE ROSE LAUNDRY
25-27 West 23 Street Bayonne, N.J.

FOR SALE DeLAVAL BOILER FEED PUMP

Size LC-315J Turbine & Pump 4650 RPM—540 PSI Steam 15 PSI Back Pressure—Pump 675 GPM at 725 PSI—New, Unused, Sacrifice Price.

LEWON BROS. 367 Bayshore, S.F. 24, Calif. PHONE AT 2-2726.

GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

MOTORS SLIP RING

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	RPM
1200	*Al-Ch.	ANY	1800
600	*G.E.	M-6345S	1800
500	G.E.	M-6345Z	1200
250	Al-Ch.	ART-626J	1800
250	*G.E.	I-M-17A-10	720
200	G.E.	I-M-16	600
200	*West.	CW-950A	514
150	Cr.-Wh.	50R	1800
150	West.	CW-874C	720
150	Al-Ch.	ANY	600
125	G.E.	I-M-15A	600
125	*G.E.	I-M-15A	600
100	G.E.	I-M-E13A-4	1800
100	G.E.	I-M-14	900
100	*G.E.	I-M	720
100	G.E.	I-M-15A	450
75	North-W	KW-50	1800
75	G.E.	MT-347-6	1200
75	G.E.	I-M-13	1200
75	G.E.	MT-356-8-75	900
75	Al-Ch.	ANY-33C	720
75	G.E.	I-M-10	720
75	G.E.	MT-352-10	720
75	G.E.	I-M-14-12	600
75	West.	CI-756A	600
60	West.	CW-FR-600C	1800
60	Al-Ch.	ARY-423C	1200
60	*G.E.	MT-356-6	1200
60	*West.	CW-762C	900
50	*G.E.	MT-536-8	1200
50	G.E.	MT-536	1200
50	West.	CW-636A	1200
50	G.E.	I-M-8	900
50	Al-Ch.	ARY-223C	900
50	G.E.	MT-346-10	720
50	G.E.	MT-546-10	720
50	West.	CW-758	720
50	Al-Ch.	ANY-26F	600
40	G.E.	I-M-11A	1800
40	G.E.	MT-336-6	1200
40	G.E.	MT-532-6	1200

MOTORS SLIP RING
Crane and hoist

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	RPM
100	G.E.	MTC-5546-8	900
80	G.E.	MTC-5552	600
50	G.E.	HIC	600
35	G.E.	MTC-5536	600
25	West.	CI-636-A	720
15	G.E.	ITC-5009	900
11	West.	CI-E464-A	900
10	P & H	BW-6	1800
5	North-W	WRC	1200
5	P & H	BW-6	1200
5	G.E.	MTC-5310	1800

SYNCHRONOUS MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	PF	RPM
1420	West.	HG	0.7	900
300	G.E.	ATI-6-285M	0.8	1200
300	*Ideal	SMM	0.8	257
275	*G.E.	ATI	1.0	450
250	Al-Ch.		1.0	1200
225	Elec. Machy		1.0	360
225	G.E.	TS-6244	1.0	300
200	G.E.	TS-7559	1.0	1800
190	Elec. Machy		1.0	720
150	Al-Ch.	SYN	0.8	1200
150	*Elec. Machy		0.8	1200
150	*West.	HR	1.0	300
125	*G.E.	TS-7641	1.0	514
125	*G.E.	TS-6214	1.0	277
125	Elec. Machy			900
125	Compton		0.9	900
115	Elec. Machy		1.0	240

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	RPM
1250	*Al-Ch.	ANX	3600
600	*G.E.	K-63458	1200
500	*G.E.	K163458	1200
350	*G.E.	KT-559A-4	1800
300	*G.E.	K-63447	1200
250	West.	CS-875-S	1800
250	G.E.	KT-559-4	1800
250	G.E.	KT-559-S	1800
250	West.	CS-8120S	1800
250	Brook	RS-28	1200
250	G.E.	I-K	600
200	*G.E.	FT-549T-2	3600
200	*G.E.	I-K-13R	1800
200	Brook	R-27	1200
200	*West.	CS-930A	900
200	*Al-Ch.		900
200	G.E.	KF-564S	720
200	*Al-Ch.	AN-37G	720
200	Al-Ch.	ARWWT	600
200	West.	CS-FR-1010	600
150	Cr-Wh.	SC-149CQ	3600
150	G.E.	I-E-13B-6	1200
150	*Al-Ch.	AN-36FI	1200
150	G.E.	I-8-FR-15	900
150	*West.	CS	600
125	*West.	CS-771-1S	1800
125	*West.	CS-761C	1800
125	Cr.-Wh.	5QR	1200
125	G.E.	K-558	900
125	Al-Ch.	AN	514
100	West.	CS-507S	3600
100	*West.	CS-760A	1800
100	*G.E.	FT-542Z	1800
100	G.E.	FTRP-543	1800
100	West.	CS-760D	1200
100	Al-Ch.	AW-23DS6	1200
100	G.E.	I-K-6	1200
100	G.E.	KT-553	1200
100	Al-Ch.	ARZ-826FS	1200
100	*G.E.	KT-556-8	900
75	*Al-Ch.	AR-445S	3600
75	G.E.	FT-529-2	3600
75	G.E.	FT-529Y-2	3600
75	Al-Ch.	APZ-5044	1800
75	G.E.	FT-537-4	1800
75	G.E.	KG-445	1800
75	*Al-Ch.	AR-505S	1800
75	G.E.	KT-546-S	1200
75	*G.E.	KT-542	1200
75	*West.	CS-664C	1200
75	*West.	CS-762	900
75	Al-Ch.	AR-226C	900
75	G.E.	I-10-K-14	720
75	G.E.	I-14-12	600
60	G.E.	KT-337	1800
60	Al-Ch.	APZ-504U	1200
60	G.E.	KT-343-6	1200
60	G.E.	K-505	1200
60	*G.E.	EF-505	1200
60	Al-Ch.	ART-505	1200
60	Al-Ch.	AR-823D	900
60	*West.	CS-762R	900
60	G.E.	Y-6-K	900
60	G.E.	KT-346-8	900

PLATERS

AMPS	MAKE	VOLTS
7500/3750	Elec. Prod.	6/12-220/440
7500/3750	Chandy.	12/24-220/440
6000/3000	Chandy.	12/24-220/440
6000/3000	Chandy.	8/16-220/440
5000/2500	Optimus	6/12-220/440
5000/2500	Chandy.	8/16-220/440
1500/750	Chandy.	12/24-220/440
1000/500	Chandy.	12/24-220/440

M. G. SETS

KW	MAKE	AC	DC
500	West.	440	220/110
400	Al-Ch.	2300	120/240
300	West.	2300	250
250	G.E.	440	250
200	G.E.	2300	250/275
200	West.	2200/4000	250
170	G.E.	220	125
150	G.E.	514	250/275
150	West.	2300/440	125/250
150	Al-Ch.	2200	250/275
125	G.E.	5000	250
125	Cr-Wh.	4150	125
100	G.E.	440	125
100	G.E.	2300	250
100	G.E.	1200	230
100	G.E.	2300/4000	250/275
100	West.	2300/4000	250/275
100	Al-Ch.	2200	250
100	Elec. Mchy.	220	125
90	G.E.	220	125
60	G.E.	220	230/250
60	G.E.	440	230/250
50	West.	220	120/125
50	Ideal	2200/550	240/250
35	West.	2300	150
30	G.E.	2200/440	125
25	West.	220	300
20	G.E.	220	250
20	Elec. Pdts.	220/440	400
20	Bogue-G.E.	220/440	125
15	Ideal	440	125

MOTORS
D.C. 230 V.

Constant Speed

HP	MAKE	TYPE	RPM
200	West.	SK-201	600
175	G.E.	KLC-11	750
100	G.E.	RC-34	2500
100	G.E.	RC-19	600
75	Roth		1800

Variable Speed

250	West.	SK-220	450/600
200	Rel.	FR-1400T	850/1200
150	G.E.	MCF	380/100
100	C.W.	CD-135-4	758/1500
100	G.E.	MPC-6	400/800
50	Al-Ch.	E-146	850/1275
35	G.E.	CD-115	500/1500
35	West.	SK-15D	350/700
30/40	G.E.	CD-123	400/1600
25/30	G.E.	RF-12	500/1600

now

Westinghouse

Single Step, Primary Resistance Type Magnetic SQUIRREL CAGE MOTOR STARTERS Three Phase, 60 Cycle, Class 11-400

Qty	HP	Volts	List Price	Our Price*
			Size 2	
1	10	220	$ 420.00	$ 147.00
3	15	220	450.00	157.00
1	20	440	484.00	169.00
1	25	440	504.00	175.00
			Size 3	
2	20	220	600.00	210.00
2	40	440	660.00	231.00
2	50	440	684.00	239.00
			Size 5	
3	60	220	2,022.00	925.00
5	75	220	2,022.00	925.00
4	100	220	2,178.00	995.00
3	125	440	2,094.00	1,075.00
9	150	440	2,094.00	1,075.00
8	200	440	2,372.00	1,175.00

*Discounts available to dealers and large users.

First Source for 47 Years for Quality Electrical Equipment

CHICAGO *Electric Co.*

1320 W. CERMAK RD. CAnal 6-2900 CHICAGO 8, ILL.

look for the WAGNER GREEN TAG CERTIFICATION

It's your guarantee that the equipment you buy is as perfect in workmanship as the day it left the factory.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	G.E. dynamom.	TLC	250	1150/2500
200	G.E. dynamom.	TLC-74	250	1150/3500
170	Cr. Wh.	151-H	230	500
150	Whse.	SK-184	230	850
100	Reliance	651-T	550	1000/1600
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Reliance (3)	985-T	230	450/1200
60	G.E. TEFC b b.	CD-135	230	1150
50	Century	DN-514	230	1150/1750
50	Gen. Elec.	CD-95	230	1800
50	Star b.b.	SQ-92	230	680
50	G.E.	CD-125	230	400/1200
50	G.E.	BF-18	230	250/1000
40	G.E. (2)	CD-93	230	1750
30	G.E.	CD-113	230	500/1500

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	2200 AC	250 DC
200	Whse.*	220/440 AC	85 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.	2300 AC	250 DC
200	G.E.	2200/440 AC	600 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	Gen. Elec.*(2)	220/440 AC	250 DC
75	Gen. Elec.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC
25	Whse.	220/440 AC	250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	G.E.	RC	600	1150
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CD	250	850
125	Gen. Elec.	CD	250	1150
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Gen. Elec.	CD-123	125/250	1200
60	Allis Ch. (3)	E-146	250	1500
60	Ideal	D	125	1150
50	Star b.b.	SQ	250	900
25	Whse.	SK-103	250	1750
20	Ideal	D-405	125	1150

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
500	G.E.	Sq. Cage	4000	1800
500	Whse.	Slipring	2200	450
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse.	Sq. Cage	2300	900
400	G.E. (2)	Slipring	440	900
350	G.E.	Sq. Cage	2200	1800
350	Cont. b.b.	Slipring	2300	900
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
300	G.E.	Slipring	2200/440	600
300	G.E. (2)	Synch.	2200/440	360
300	Whse.	Sq. Cage	2200/440	720
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	440	450
250	Ideal	Slipring	2200	900
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Gen. Elec.	Synch.	220/440	450
250	Whse.	Slipring	440	1200
250	G.E.	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G.E.	Sq. Cage	440	600
175	G.E. (2)	Synch.	220/440	720
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E.	Slip Ring	220/440	450
150	G.E. (2)	Sq. Cage	2200/440	1800
150	Allis Ch. b.b.	Sq. Cage	2200/440	720
125	Whse. TEFC	Sq. Cage	2200/440	720
125	G.E. TEFC	Sq. Cage	2300	3600
125	Ideal	Slipring	4000/2200	900
100	G.E. (2)	Slipring	2200/440	720
100	Al. Ch. TEFC	Sq. Cage	2200/440	720
100	Smith b.b. (6)	Sq. Cage	220/440	1800

THOUSANDS OF MOTORS & GENERATORS IN STOCK

AC & DC . . . all sizes and types up to 1000 H.P. . . . all covered by the WAGNER guarantee.

Arthur Wagner Co. Certified

MO nroe 6-7409
1435 W. RANDOLPH ST
CHICAGO 7, ILLINOIS

VIRTUALLY NEW AIR COMPRESSORS

(4) INGERSOLL RAND Model 125M Type 40.2 Stage, Air Cooled with intake filters. 550 CFM. Powered by 125 HP 220/440 Volt 60 cycle, 3 phase, 1200 RPM, Squirrel Cage Induction Motors, with Reduced Voltage Starters.

(2) I-R Aftercoolers 59PL-12 with Condensate Trap.

(1) Air Receiver I-R Size R-9—54" x 14' ASME.

BUILT 1955—USED LESS THAN ONE YEAR
LOCATED IN NEW YORK

LURIA BROTHERS COMPANY, INC.
INDUSTRIAL EQUIPMENT DIVISION
600 Philadelphia Bank Bldg.
Philadelphia 7, Penna.
Rittenhouse 6-7455

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.
Will sell turbines separately if desired. *Price reasonable.*
Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
706 DONOVAN BLDG.
DETROIT 1, MICH.

BOILERS

HI-PRESSURE
Complete stock from 10-2,000 h.p.
Nation's largest inventory. New & Used
WABASH POWER EQUIPMENT
31 E. CONGRESS, CHICAGO 5, HA 7-4855

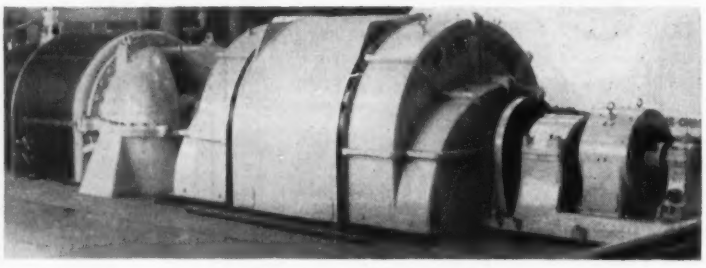
TURBO-GENERATOR

2500 KW Whse. Cond. 3/60/2400 V.
3600 RPM 400 PSIG 750°
2000 KW Al.Ch. Cond. 3/60/600 V.
3600 RPM 400 PSIG 750°
2000 KW Whse. Cond. 3/60/2400/4150
3600 RPM 240/400 PSIG 750°
1500 KW Ell. Cond. 3/60/2400/4150 V.
3600 RPM 400 PSIG 750°
300 KW G.E. Non-C. 3/60/480 V.
3600 RPM 150 PSIG 5#BP

Full line power equipment

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

8000 KW PACKAGE UNIT



Consisting of 8000 KW, 3600 RPM, 11,500 Volt 3 Phase, 60 Cycle, 450 PSI Parsons Steam Turbo Generator complete with all auxiliaries, modern switch gear and transformers. 90,000 lb. per hour, 450 PSI, Babcock and Wilcox Boiler complete with all auxiliaries. Plant was used as stand-by and is in new condition. Can be inspected any time. *Immediate delivery.*

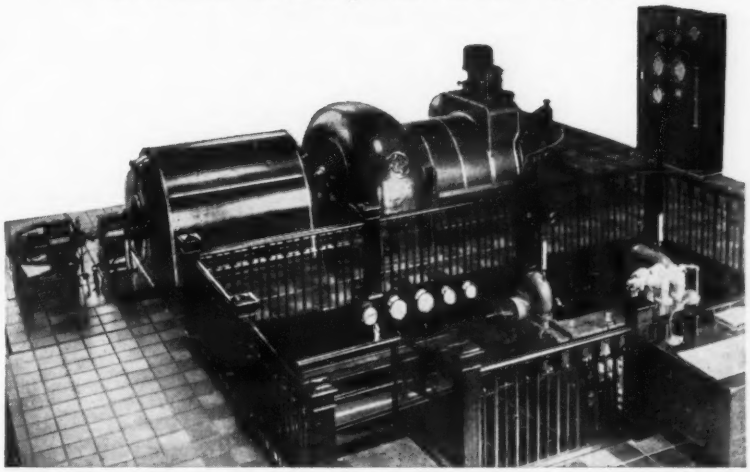
GENERAL MACHINERY LIMITED
GRANVILLE ISLAND • PACIFIC 3487 • VANCOUVER, B. C.

TRANSFORMERS

3—500 KVA 1/60/2300-4000Y to 230/460 Westinghouse OISC, with taps
3—833 KVA, 1/60/34500/460 Moloney OISC, with taps
2—250 KVA 1/60/2400-240/480 Moloney, OISC, type YC, with taps
1—300 KVA, 3/60/4160-240 Wagner, type HPB-ITE Unit Substation
1—200 KVA, 3/60/4160-240 Wagner, Type RPB-ITE Unit Substation

CASH
For Surplus Electrical Equipment
BENSON-WILIMZIG, INC.
1704 North 8th St., St. Louis 6, Mo.
Phone GArfield 1-4290

MODERN 400 LB., 750 DEG. TURBINE-GENERATOR WITH A 66,000#/HR B&W BOILER



THE ABOVE 3750 KVA GENERAL ELECTRIC IS IN VERY GOOD CONDITION TURBINE #43103 GENERATOR #5406647 3/60/2300/4160V DIRECTLY CONNECTED EXCITER. COMPLETE WITH SURFACE CONDENSER, SWITCHBOARD, AND ALL AUXILIARIES.

ALSO IN STOCK

1—12,500 KW 350#, 600 DEG., 13,200V
1—10,000 KW 600#, 750 DEG., 12,000/13,200V
1— 2,500 KW 250/400# 13,800V, Automatic Ext. 50#

CHARLES WEAVER, INC.

19701 James Couzens Hwy. Tel: BRoadway 3-1901 Detroit 35, Michigan

FOR SALE

Immediate Delivery — Complete Modern Power Plant comprising of:

1—2500 KVA Westinghouse Condensing Turbine Generator Unit, 3600 RPM, Impulse Type 2400 volts, 3 phase, 3500 square ft. surface condensor, with auxiliary equip.

1—3750 KVA Westinghouse Condensing Turbine Generator Unit, 3600 RPM, 750° F., 4160 volt, 3 phase, 4500 square ft. surface condensor, with auxiliary equip.

Also one Westinghouse Turbine Generator 781 KVA 2300 Volt 3600 RPM.

— BOILERS —

B&W — Riley — Heine 350-425 H.P. All equipment in good condition recently removed from service.

J. J. BROWN
C. B. EQUIPMENT COMPANY
1800 Locust St., St. Louis 3, Mo.
Ph. Chestnut 1-1101

FOR SALE

2812 KVA DIESEL GENERATOR UNIT

2812 KVA Crocker Wheeler generator, 3 phase, 60 cycle, 12,000/6900/4160/2400 volts direct connected to 3000 HP Busch-Sulzer (Nordberg) diesel engine, 10 cylinders, 240 RPM, complete with auxiliaries as in operation.

Used only 5 years—Excellent condition

INTERNATIONAL POWER MACHINERY COMPANY
1610 Union Commerce Building
Cleveland 14, Ohio

MISS POWER EQUIPMENT SAYS,

"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed New and Rebuilt Motors"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
350	A.C. S.B. Drip	ARWW-626	3600
300	G.E. S.B. Open	IK	1800
300	A.C. S.B. Open	AR-630	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1002	600
250	G.E. TEBB, 2300 V	K	1800
250	G.E. S.B. Open	KT	1800
250	F.M. B. Open	H	1800
250	G.E. S.B. Open 2200 V	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	F.M. B.B. Open	H-207	1800
200	G.E. TEBB	K	1800
200	A.C. S.B. Open	ARW-626	1800
200	G.E. S.B. Open	AT-558	1800
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-158	1200
200	G.E. S.B. Open	KT-582	1200
200	G.E. S.B. Open 2200V	IK	1200
200	G.E. S.B. Open	IK	900
200	West. S.S.B. Open	CS-876C	900
150	G.E. TEFCBB	K-6328	3600
150	G.E. TEFCB XP	K	3600
150	G.E. TEBB	K	1800
150	West. S.B. Open 2200 V	CS	1800
150	G.E. S.B. Open	IK	1800
150	West. S.S.B. Open	CS-772C	1200
150	G.E. S.B. Open	IK	1200
150	G.E. S.B. Open	KT-558	900
150	G.E. B.B. Open	KT-558	900
150	G.E. S.B. Open	IK	720
150	Howell BB Open		720
125	G.E. TEFCBB	K	3600
125	West. B.B. Open	CS-761C	1800
125	West. S.S.B. Open New	CS-607	1800
125	G.E. S.B. Open	IK	1800
125	West. S.B. Open	CS	1800
125	West. S.S.B. Open 2200 V	CS-607	1800
125	G.E. S.B. Open	KT-553	1200
125	G.E. S.B. Open	IK	1200
125	West. SSB Open	CS-764C	1200
125	G.E. S.B. Open	IK	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
100	A.C. S.B. Open	AR-505S	3600
100	Reliance B.B. Open	AA-504	3600
100	F.M. B.B. Open	H-121D	1800
100	G.E. S.B. Open	KT-343	1800
100	Burke B.B. Open	N-505	1800
100	A.C. S.B. Open 2200 V	ARX	1800
100	Century S.B. Open	SC-505	1800
100	G.E. S.B. Open	KT-347	1200
100	West. SSB Open	CS-607	1200
100	West. SSB Open	CS	1200
100	A.C. SB Open 2200 Volt	ARX	1800
100	A.C. TEFCBB	ARZ	1200
100	West. S.S.B. Open	CS-607	1200
100	West. S.S.B. Open	CS-774C	900
100	G.E. S.B. Open	IK	900
75	West. B.B. Splash	CS-445	3600

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Large line of motors, Control Equipment, AC and DC Generators, MG sets and transformers. PHONE or WIRE on COLLECT

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LARGE ELEC. POWER EQUIPMENT
SELECTED STOCK ITEMS
RE-NU-BILT—GUARANTEED—RE-NU-BILT
COMBINATION MILL DRIVES—
D.C. MOTORS WITH M.G. SETS & CONTROLS
PACKAGE DRIVES IN STOCK

1—2250 HP Elliott 300 V. 200/300 RPM DC Motor with 2400 KW GE MG Set. 300 V. DC 2300/4600 V. 450 RPM 3 ph. 60 cy.

1—1375 H.P. G E., MCF, 415 V, 1300 RPM D.C. motor with 1100 KW G.E. MG Set 415 V. DC, 2300/4000 V, 720 RPM 3 ph 60 cycle.

1—1200 HP G.E. MPC, 600 V, D.C. Motor, 450 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 KP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT	6900	1187
1	1100	F.M. BB	SF806S	4800/2400	1800
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D P.	2300	500
1	600	Whse.	CW-432D-15	440	1778
1	500	Whse.	CW	550	350
1	400	Whse.	CW	440	514
1	350	Cr. Wh.	SIZE-718R	208/406	1765
1	350	G.E	IM-17A	440/2200	720
1	350	Whse.	CW-1039C C-15	440	720
1	250	Cr. Wh.	MT-424Y	4000	257
1	250	G.E.	SIZE-290	2300	350
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
2	200	G.E.	IM	2200	435
1	200	G.E.	MT-557Y	2200	1760
1	150	Whse.	CW30E17	2300	435

SQUIRREL CAGE

1	800	G.E.	KT-573	2300	1180
1	500	G.E.	FT-559AY	2300	3600
4	500	Whse.	CS-1216	2200	500
2	450	Whse.	CS-1420	2300/4150	354
1	400	G.E.	1K	2200	500
1	200	G.E.	1K-17	440	580
2	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580
1	150	G.E.	1K-15A	2300	860

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-SL	13800/6900	514
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2300/4600
2	2100/1750	G.E.	514	250/300	2300/4600
1	2000	G.E.	514	600	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1000	G.E.	900	260	6600
2	1000	G.E.	720	600	6600/13200
1	1000	G.E.	514	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
3	300	G.E.	1200	250	2300
1	250	Whse.	1200	275	2300
1	200	El Mhy	1200	250	2300/4600
1	800	Whse.	1200	600	2300
1	200	Whse.		550	2300
1	200	G.E.	1200	250	550/2300
1	200	Cr. Wh.	1200	250	440
1	150	Whse.	1200	275	2300

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
1	3000	G.E.	OISC	3	33000x2300
1	1500	G.E.	PYRANOL	3 auto	4000/4200/4400
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x85/55
1	833	G.E.	OISC	1	13800x460
3	500	KUHL	OISC	1	13800x6900
3	500	KUHL	OISC	1	4800/2400x 240/480
3	200	Al. Ch	OISC	1	2300x230/460

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E	60/50/60	660/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300
1	200	G.E.	60/3000	440/800

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	10000	Whse.	Condensing 650 lbs. 750° F.T.T. Surface Condenser Dir. Conn. Exciter.
1	5000	G.E.	Auto Extraction Condensing 650 lbs. 750° F.T.T. Auto.
1	1000	Moore	Auto. Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.

BELYEA COMPANY INC.

43 Howell St., Jersey City 6, N. J.

Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	750	G.E.	K	1	4600-120/240
1	750	G.E.	HT	3	4150Y-208/416
2	250	G.E.	H Pyranol	1	2400-4800-8320Y 120/240
2	250	West.		1	2300/4600-230/460
3	200	G.E.	H	1	7800-15600-220/440
1	150	Elsier	OA	1	4160-240/480
2	3000	Maloney	TCR	3	7200/6600-4160/2400
5	50	G.E.	F.S	1	60-2400/4160-240/480
3	75	G.E.	H Form	1	60-2400-120/240
4	25	West.	Hiperiol	1	2400/4160-120/240
3	15	West.	H Pyranol	1	6900/11950Y-120/240
6	15	Maloney	KL	1	2400/4160Y-120/240
1	50	Amer.	Abestol	3	4160-120/208Y

SYNCHRONOUS MOTORS

Qu	HP	Make	Speed	Type	Volts
1	100	G.E.	900	TS	2300
1	125	G.E.	600	TS	2300
1	125	F.M.	900		4800
1	150	G.E.	1800	TS	220/440
2	150	Allis-Ch.	360		2200
1	150	West.	900		220
1	300	F.M.	720	TEFC	2300
1	500	West.	450	HR	440
1	1000	West.	360	Mill	2300/4150

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	15	G.E.	900	MT-542	440
1	25	G.E.	900	MT-526	440
1	60	G.E.	1800	MT	220
1	60	Ideal	900	AV	220
1	75	G.E.	600	IM	440
3	150	Allis-Ch.	1800	AY-RW	220
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	220
2	100	West.	1800	T.E.F.C. B.B.	220

SQUIRREL CAGE

Qu	HP	Make	Speed	Type	Volts
1	25	G.E.	1170	405TEFC	220/440
1	40	Wagner	1750	CPI-444 TEFC B.B.	440
2	75	West.	1180	CS-607	440
1	100	G.E.	1775	KTP-543	440
1	40	Wagner	1200	CPI-445 TEFC B.B.	440
1	150	G.E.	720	KT-562	440
2	250	G.E.	1790	K.T.E.F.C.	2300
1	275	G.E.	1200	KT559BS	2200
1	300	G.E.	1800	K-4150V	new
1	400	Cont.	1200	N806S	2300

MOTOR GENERATOR SETS

Qu	K.W.	Make	Speed	Volts DC	Volts AC
1	10	G.E.	1800	125	220/440 A.C.
3	60	F.M.	1200	125	220 v. 3yn.
1	150	Cr. Wh.	600	125	220/440
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R.
1	1000	West.	720	600	2300/4160Y

D.C. 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	75	C.W.	900	WP T.E.F.C.
1	125	G.E.	1700	RC
1	150	C.W.	900	WP T.E.F.C.
1	250	Allis Ch.	1750	FBL149BB

A.C. HOIST MOTORS

Qu	HP	Make	Type	Speed	Volts
1	35	G.E.	MTC	565	440
2	300	G.E.	ITC-5017	600	440

"FOR POWER"
J.L. HEMPHILL & CO.
1003 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK - LONGACRE 5-3227
PHONE NEW JERSEY - UNION 3-2400

DIESEL GENERATOR SETS

2—McIntosh-Seymour (Alco) 950 HP 8 cyl. 225 RPM, 875 KVA Westinghouse 3 phase, 25 or 60 cycle alternators, 20 KW exciters.

1—Baldwin DeLavergne 1140 HP 6 cyl. 4 cycle, 200 RPM, 1000 KVA Elliott 3/60/2400 generator. 20 KW exciter.

Complete plant installation with all accessories. Priced attractively.

WHISLER EQUIPMENT CO.
611 Olive St. St. Louis 1, Mo.

4 GOOD BUYS

2—1000 HP GE 1800 RPM K-63475 2300/60/3 with control—New
1—700 HP Westinghouse CS-3402 2200/4000/60/3 1800 RPM
1—720 HP Westinghouse CS-39D 2200/60/3 1800 RPM

BERRETINI ELECTRIC CO. Ph. Wilkes-Barre
380 W. Main St., Plains, Pa. Valley 2-5061

STEAM GENERATOR UNITS

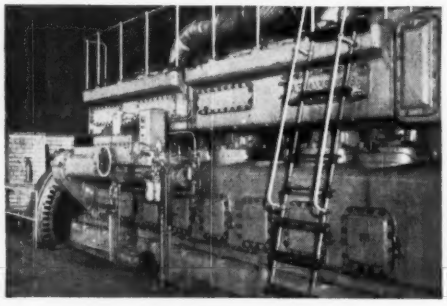
400 HP Uniflow Vertical 4 cyl.—Generator
312 KVA 3/60/240 volt, 360 RPM, w/all controls.
75 KW Chuse, generator 3/60/440 vt. w/controls.
450 HP General Electric Turbine, 1200 RPM.

GENERAL MACHINERY & EQPT. CO. INC.
809 Woodland Kansas City 6, Mo.
Telephones Victor 2-0018 & 2-0019.

MODERN SLOW SPEED DIESEL ELECTRIC GENERATING SET

OFFERED AT CONSIDERABLE SAVING

ALSO AVAILABLE
•
WORTHINGTON BB5
100 KW
600 RPM
3/60/480
•
Other Sets from 20 KW to 1200 KW



COMPLETE WITH ALL AUXILIARIES
—
Other Sets from 20 KW to 1200 KW

FAIRBANKS MORSE MODEL 33F16
1125 KW 300 RPM 3/60/480V

NATIONAL METAL & STEEL CORP.

1251 NEW DOCK STREET, TERMINAL ISLAND (LOS ANGELES HARBOR), CALIF.
CALL LOS ANGELES NEvada 6-9871

DIESEL DIVISION

FOR SALE

ON LOCATION

MODERN POWER PLANT

1875 KVA WORTHINGTON MOORE TURBINE 400 PSI, 700°F Condensing, driving 2300 Volt CROCKER WHEELER GENERATOR 25000#/Hr. 450 PSI, 738°F, Coal Fired BOILER; includes all auxiliaries, controls, 25 Ton powerhouse crane and coal handling facilities.

(Will sell boiler or generator set separately)

3 PPM VAPOR EVAPORATOR

GRAHAM 8700 to 15,000 lbs./hr. complete with all auxiliaries. New 1954.

BOILERS

400 HP B.&W. (Sterling) 160 PSI Oil/Gas fired, ASME, New 1947. (2) Comb. Engrs. M-2 Package 175 HP—275 PSI oil fired (3)

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SEND US YOUR INQUIRIES

GENERATOR SETS

500 KVA RATHBUN JONES Gas Engine Set 3/60/2300V

540 KW — DC — 120/240 Volts Steam Turbine 200 PSI

125 KW G.E. 2300 V 3/60/514 RPM WORTHINGTON Gas Engine 5 KW Exciter and Panelboard

SYNCHRONOUS MOTOR

700 HP, 4150/2400V, 514 RPM.

HEAT & POWER Co., Inc.

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Diamond 3-4890

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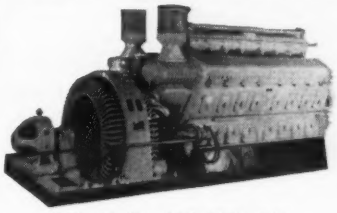
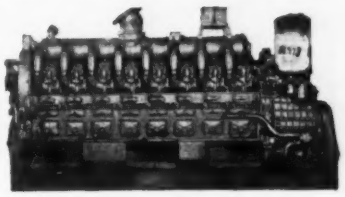
DIESEL DRIVEN GENERATORS — PRICED TO SELL



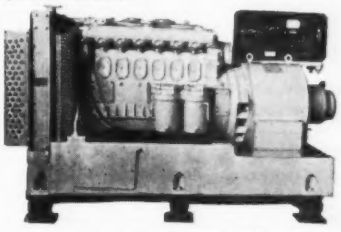
G.M. 16-567—1250 KVA—A.C.

1250 KVA 4600/2300 volt 3 phase 60 cycle 720 RPM Westinghouse sync. A.C. generator—80% P.F.—S.O. 6P455 with direct connected 10 KW exciter. Spare parts include (1) factory reconditioned blower; (1) extra blower; and a quantity of new pistons, liners, heads, bearings, etc. Unit complete with Westinghouse oil circuit breaker —15000 volts—type F-124—600 amps—60 cycle —solenoid operated—mounted in drawer-type cubicle 20" wide—44¼" deep—88" high. Motor operated rheostats.



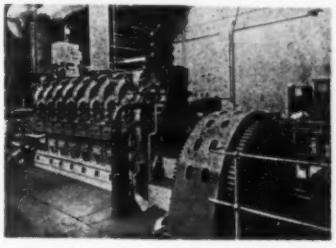
G.M. 16-278A—1200 KW—D.C.

(1) 16-278A diesel generator set. GENERATOR: 1200 KW—525 volts DC—3000 amps—720 R.P.M. —shunt wound. (Generator not shown) ENGINE: #11977—complete with full flow filters; Harrison heat exchangers; strainers; pyrometers, etc. 1600 HP at 720 RPM—formerly in Navy DE. Never in commercial use. Generator is totally enclosed air-cooled drip-proof marine type mfg. by Allis-Chalmers. Excellent for dredges and other DC requirements



G.M. 6-71—60 K.W.—A.C.

GM 6-71 radiator cooled self-contained diesel generator sets—60 KW 440 or 220 volts 60 cycle 3 phase 1200 RPM with direct connected exciters and self-contained panel boards, including rheostats, SilverStat voltage regulator, ammeters, voltmeters. These units are guaranteed to be in perfect running condition and can be demonstrated at our plant. The generators were made by Delco and are ball-bearing drip-proof marine type. Engines are famous GM 6-71 6-cylinder 2-cycle 4¼ x 5—equipped for electric starting. Equipped with radiator, self-contained fuel tank, all controls, etc. Mounted on pre-fab sub-base. 8 available.



1250 KVA DIESEL A.C. POWER PLANT

Modern 1250 KVA 1000 KW 420 volt 3 phase 50 cycle 4-wire diesel driven alternator set, mounted on a fabricated baseplate and direct coupled at 750 RPM, incorporating: ENGINE—G.M. 16-278A —#11691, dated 1943; 1700 b.h.p. 16-cylinder 2-stroke cycle; cold starting; cylinders 8¾" x 10½"; complete with hydraulic governor and overspeed trip. Direct coupled to: ALTERNATOR —by Electric Machinery Co—#97688. Revolving field, 0.8 P.F.; 1720 amp. per phase; 750 RPM; single pedestal oil ring lubricated bearing; direct coupled exciter 12.5 volts 52 amps. Engine has standard fittings and ancillaries.

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368 CFM	100 psi	12x10	IR-CP—Penn
368 CFM	100 psi	10-6x7 Joy	WN112B
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420 CFM	49 psi	12x9 Ing.	ES—Oil-Less
465 CFM	100 psi	12x11 Penn	3AT
528 CFM	100 psi	14x12	IR-CP—Penn
585 CFM	100 psi	15—9½x12	IR—XRE 3-60-4160
590 CFM	100 psi	13½—8x8 Penn	DE2
669 CFM	50 psi	15x11 Worth.	HB or HS
676 CFM	100 psi	15—9¼x12 Ing.	XRB
686 CFM	100 psi	14x13 Worth.	HB
868 CFM	100 psi	17—10x12 Penn	DE2 150 HP—
877 CFM	100 psi	17—10½x14 Ing.	XRB
1002 CFM	100 psi	19—11x2 Chic.	OCB
2900 CFM	100 psi	29—18x21 Ing.	PRE2 3-60-2300
7950 CFM	200 psi	33—7¾x27 Ing.	PRE2 4C
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37 Years Dependable Service

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H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
400	4000/2300	Whse.	720
350	4000/2300	G.E.	720
300	2300	G.E.	450
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	220/440	Whse.	720
125	2200	G.E.	600
100	440/220	G.E.	720

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
150	440/220	G.E.	TS	720
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
500	2200/4000	Elliott	SC	1800
350	2300/440	G.E.	IE-K	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
250	440/220	G.E.	KT	720
200	440/220	G.E.	KT	1800
200	2200	G.E.	KT	1800
200	440/220	G.E.	KT	720
200	2200/440	G.E.	IE-K	1200
150	440	Whse.	X-prf.	3600
150	2200	Al. Chal.	AR	1800
150	440/220	G.E.	KT	720
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2300/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200
75	2300/440	Whse.	TEFC	1200

A. C. GENERATORS

1—320 kva, 660 rpm, 2300/440/220 V., G.E.
1—360 kva, 900 rpm, 2200 V., Whse.
1—225 kva, 60 rpm, 220/440 V., G.E.
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

9—1600 amp ITE, 3 pols, 600 V.
6—FKB-155-28, 600 amp., 15,000 V. G.E.
1—400 Amp., Condit. 3P, 25 KV outdoor
1—400 Amp. R. Smith, 3 P 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1800
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	850

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	440	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al. Ch., 2400/4160Y—600 volts, 3 ph
3—500 kva, G.E., 13,800—300 V.
3—333 kva, G.E., 13,800—2300 V.
2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
1—200 kva, Al. Ch., 6900—220 V., 3 ph.
3—200 kva, Whse., 4600/2300—230/115 V.
1—200 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—150 kva, Al. Ch. 2400—220 V.
3—150 kva, Al. Ch. 440-220 V., dry New
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, G.E., 2400—120/240 V., Pyr.
6— 50 kva, G.E., 13800—120/240 V.

only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

TRANSFORMERS

2—2000 Kva GE 13200-2400 Scott Tap
7—1667 Kva GE 13800-600
3—1000 Kva GE 13800-460
15— 50 Kva GE 33000-2400 New
120— 25 Kva GE 33000-2400 New

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TRANSFORMERS • SALES
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REpublic 2-2104; 2-2105

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425# PSIG, 3600 RPM, 2400/4160 volts, 3-phase, 60 cycle. Exhaust pressure 5#G. Condenser & condenser pump & motor. Installed new 1939—very little operating time—like new.

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2500 to 3000 KVA Total capacity at 66,000—13,200 volts. 1500 KVA Total capacity at 66,000—7,200 volts.

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2—1500 KW Turbo-generators—1 New 1948 400#. 1000 KVA Turbo generator.
B&W Boiler, 45000#/Hr. at 450#—New 1951.
B&W Boiler, 27000#/Hr. at 450#—New 1948.
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SPECIAL OFFERINGS

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1—7500 KW 2400/4160 volt Condensing—400#—700° FTT. New 1949
1—3500 KW 2400/4160 volt Condensing—400#—700° FTT. New 1941
1—1000 KW—240/480 volt—130/250# Cond. Auto. Extraction—15#—New 1945
1—1000 KW 480 volts—225# Condensing—Auto. Extraction—20#
1—300 KW—480 volts—210# Condensing—Auto Extraction—40#
1—250 KW—240 volts—130#—Non-Cond. 10 12# Back pressure

TRANSFORMERS

1—500 KVA 4160/480 V. Pyranol 3 ph.
3—1667 KRH—13800/600 volts New 1948

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150 KVA GE-Van Severin
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250-420-545 & 1250 KVA Fairbanks
350 KVA General Motors

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1250 KVA GE non-con.-bleeder
750-625-375-250-62 KVA Units

BOILERS
B&W: two 600 & one 297 HP; strt tubes
B&W: three 500-248-150 HP; bent tubes
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300 HP Cooper-Bessemer, 8 cyl. 600 RPM (Gas)
450 HP General Electric Turbine, 1200 RPM
225 HP Buda Diesel, 6 cylinder, 900 RPM
75 KW Steam Generator Set, 220 volt.

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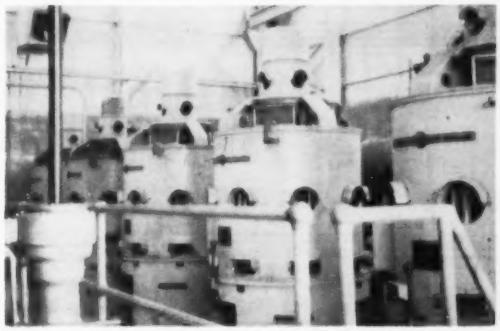
2	Chapman, 20" Cone Valve, Oil operated. Fl. & El.			
3	Chapman, 24" Gate Valve operated by Electric Motor. Fl & Fl.		8,000.00 ea.	2,000.00 ea.
4	Chapman, 10" Gate Valve, Fl. & Fl.	6		
5	Pelton, 10" Surge Suppressor.	6		
6	Vertical General Electric Motors, 2500 H.P. 900 R.P.M. Form V, 4000 Volts. Amp. Arm. 280. Power Factor 1.0. K.V.A. 1940, 3 phase, 60 Cycle Exciter Volts. 125. Amp. Field 55 instructions G.E.H. 527 Direct connection to pump shaft.	6	60,000.00 ea.	15,000.00 ea.



Item No.	Description	Quantity	Replacement Cost	Offered For
7	General Electric Control Cabinets containing meters and D.C. portion of motor controls electric operated oil breakers not included.	6	$10,000.00 ea.	$2,500.00 ea.
23	Link Belt, "Thru-Clean" Bar Rack with mechanical rakes, electrically driven. 5 ft. width Link Belt, Traveling Water Screens, Model 45 Order No. PK1850.	3	$15,000.00 ea.	$3,750.00 ea.
24	Builders-Providence, 6000 lb/day "Chlorinizer."	2		
26	Fairbanks-Morse Platform Scales 8000 lbs. cap.	2		
34	Builders - Providence 54" x 32" Venturi Meter ⅝" steel plate (Register 0-150 m.g.d. and Mercury Mamometer in Pumping Sta.).	1		

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Express Type, 3-drum, with integral superheater separately fired.
Includes boiler, superheater, economizer, 7 fuel oil burners, soot blowers.
Pressure 634 psi, temp 850° F.
Furnace Vol: boiler 310 cu. ft., superh. 247 cu. ft.

60,000 Lbs.

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3 Foster Wheeler
"D" Type, 2-drum, with integral superheater fired between boiler tube bank.
Includes boiler, superheater, economizer, 3 fuel oil burners, soot blowers.
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We own and stock these boilers. Inspection Invited at Utica, N.Y. Subject to prior sales.

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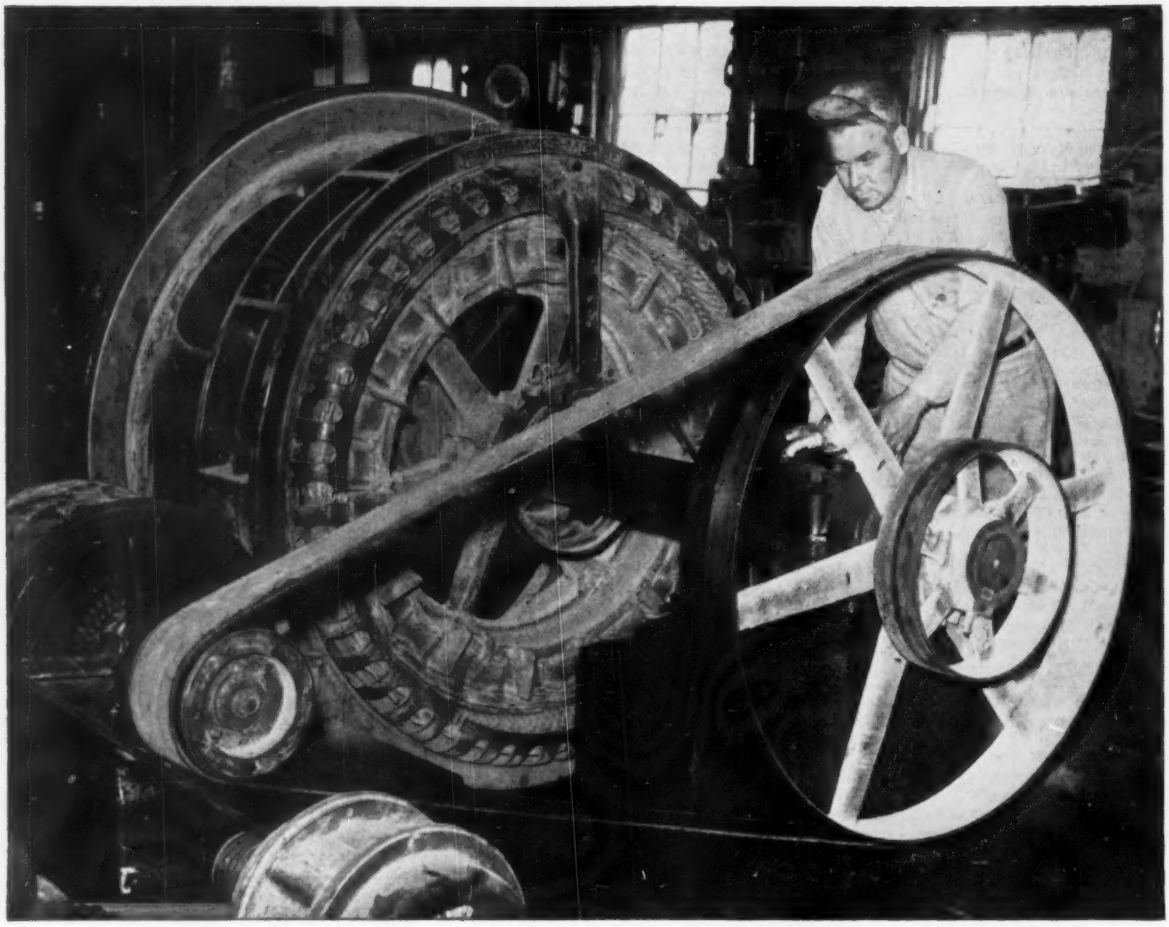
B.F.Goodrich report:



They wanted a belt that wouldn't stretch

B. F. Goodrich improvements in rubber brought extra savings

Problem: This is where they make the power to run all the equipment in a sand and gravel plant. There used to be a leather belt on the generator, but it stretched so badly it had to be removed and shortened again and again.

What was done: Then a B.F.Goodrich man got them to try a B.F.Goodrich "Highflex" belt—an improved design that has practically no stretch, better resistance to shock loads. The special rubber compound used in the belt can stand constant flexing, makes "Highflex" a more flexible, longer-lasting belt.

Savings: The B.F.Goodrich belt was installed, and lasted nearly five years, running 10 hours a day, 6 days a week, 9 months every year. No repairs were needed, not a minute was lost in shutdowns.

Extra benefits: This B.F.Goodrich belt, joined by the Plylock belt splice, eliminates the need for belt fasteners. Without the use of metal fasteners, laces or stitching, the Plylock belt joint produces a long-lasting, flexible splice practically as strong as the belt itself. Because 9 out of 10 belt failures are caused by metal fasteners working out, the Plylock splice often *triples belt life.*

Where to buy: Your B.F.Goodrich distributor has full information on the transmission belt described here. And, as a factory-trained specialist in rubber products, he *can* answer your questions about *all* rubber products B. F. Goodrich makes for industry. *B. F. Goodrich Industrial Products Co., Dept. M-133, Akron 18, Ohio.*

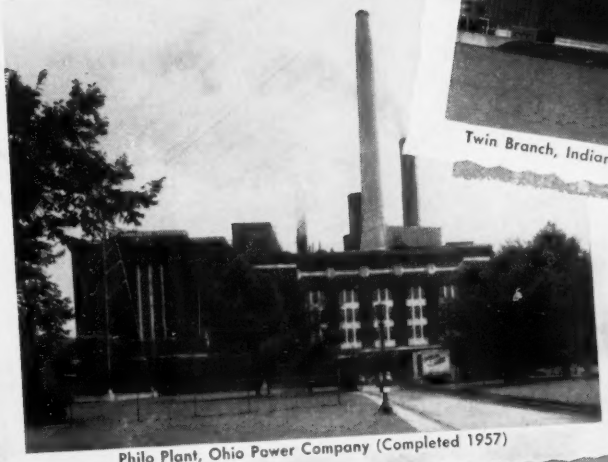
B.F.Goodrich

INDUSTRIAL PRODUCTS

17 years with American Gas and Electric

from Twin Branch in '40 . . .

Twin Branch, Indiana & Michigan Electric Company (Completed 1940)



Philo Plant, Ohio Power Company (Completed 1957)

. . . to Philo in '57

Grinnell has supplied pipe hangers for the following plants of American Gas and Electric System:

Utility	Station	Unit No.	Completion Date
Indiana & Michigan	Twin Branch	3	1940-41
Appalachian Electric	Cabin Creek	8, 9	1942-43
Ohio Power	Philo	4, 5	1941-42
Indiana & Michigan	Twin Branch	4	1944
Ohio Power	Tidd	1, 2	1945-48
Appalachian Electric	Philip Sporn	1	1950
Ohio Power	Philip Sporn	2	1950
Appalachian Electric	Kanawha River	1, 2	1953
Ohio Power	Muskingum River	3, 4	1957
Appalachian Electric	Glen Lyn	6	1957
Ohio Power	Philo	6	1957
Ohio Power	Kammer	1, 2, 3	1958
Appalachian Electric	Clinch River	1, 2	1958

Grinnell Pipe Hangers have met the challenge of skyrocketing pressures and climbing temperatures

Back in 1940, American Gas and Electric Company System made industry history when Unit #3 at the Twin Branch plant of Indiana & Michigan Electric Company went on the line at 2300 psi and 940 F. Grinnell designed the pipe suspension system and supplied the pipe hangers for this pacesetting unit.

In the years that followed, as other AGE stations and units were built, Grinnell continued to serve this progressive utility company. When the supercritical Philo plant of Ohio Power Company was conceived, Grinnell again was selected to engineer the pipe suspension system. Working in an uncharted area of supercritical pressures, Grinnell engineered a system to provide the required safety, and furnished all of the pipe hangers and supports for this 4500 psi — 1150 F steam unit.

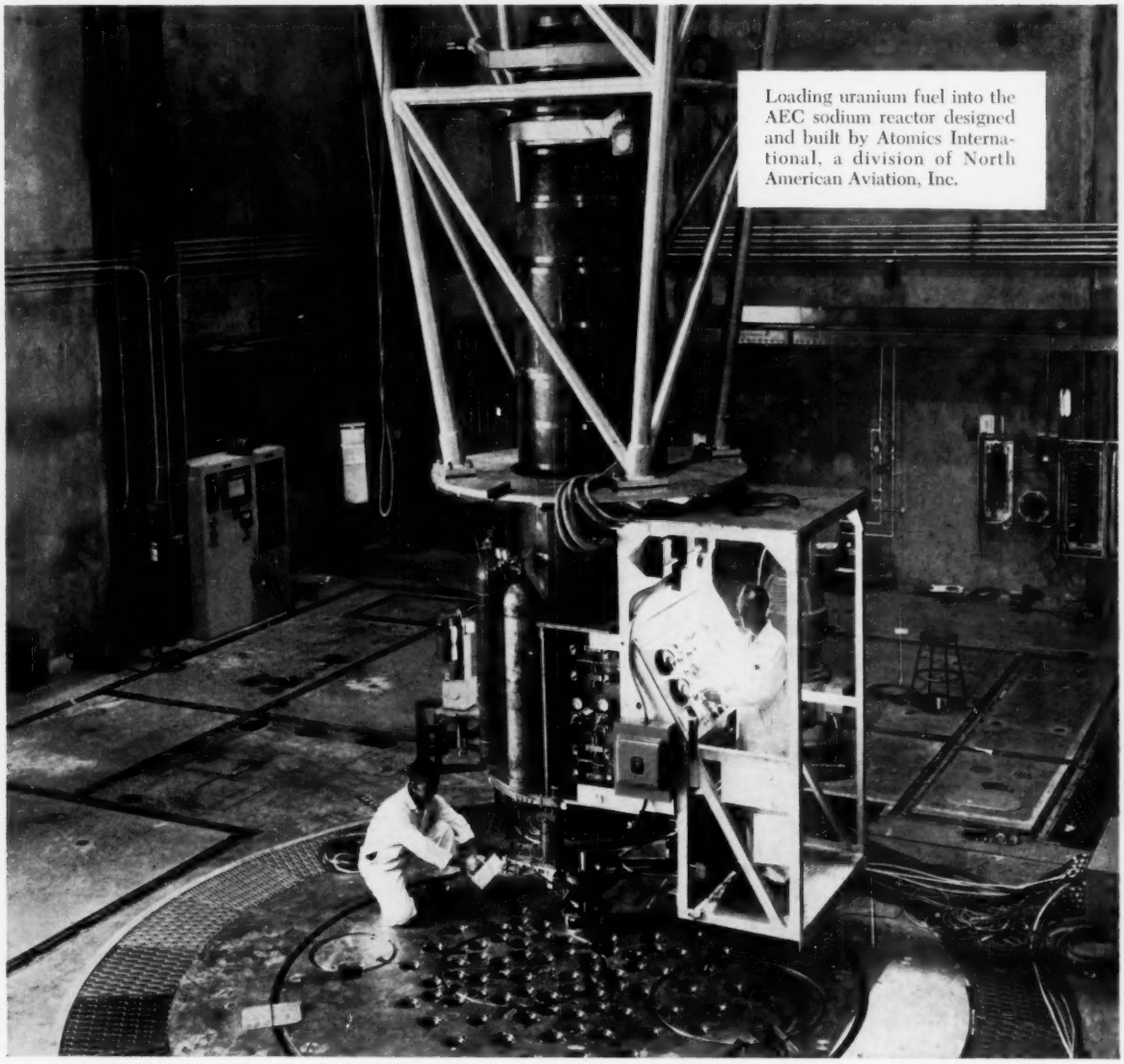
Grinnell invites *your* problems in pipe suspension. Remember, you benefit from more than a century of piping specialization when you call on Grinnell.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIES

Grinnell Company, Inc., Providence, Rhode Island • **Coast-to-Coast Network of Branch Warehouses and Distributors**

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



Loading uranium fuel into the AEC sodium reactor designed and built by Atomics International, a division of North American Aviation, Inc.

Water for new Atom Power Plant is 99.999992% pure!

● Southern California Edison Co. . . . now generating current from this new reactor in the Santa Susana Mountains . . . is the first private utility to produce electricity from a non-military reactor.

As in any system using water or steam in or near an atomic reactor, the quality of the water at the Santa Susana plant is important. Suspended and dissolved mineral solids must be removed to prevent them from depositing in boiler tubes and turbines. In other types of reactors, these solids can also pick up and carry radioactivity and could make turbines and other equipment difficult for maintenance or repair.

Although this plant's water supply is a clear well water, it contains almost 600 parts per million of hardness salts and other dissolved solids. The Permutit softener and demineralizer reduce these solids to 1/12 part per million . . . a purity of 99.999992%!

Permutit was chosen to design and supply this precise and critical equipment because of its long experience in water conditioning.

If your problem is Water . . . for industrial, municipal or home use, we'd like to discuss it with you. Address: The Permutit Company, Dept. P-10, 330 West 42nd St., New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ontario.

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